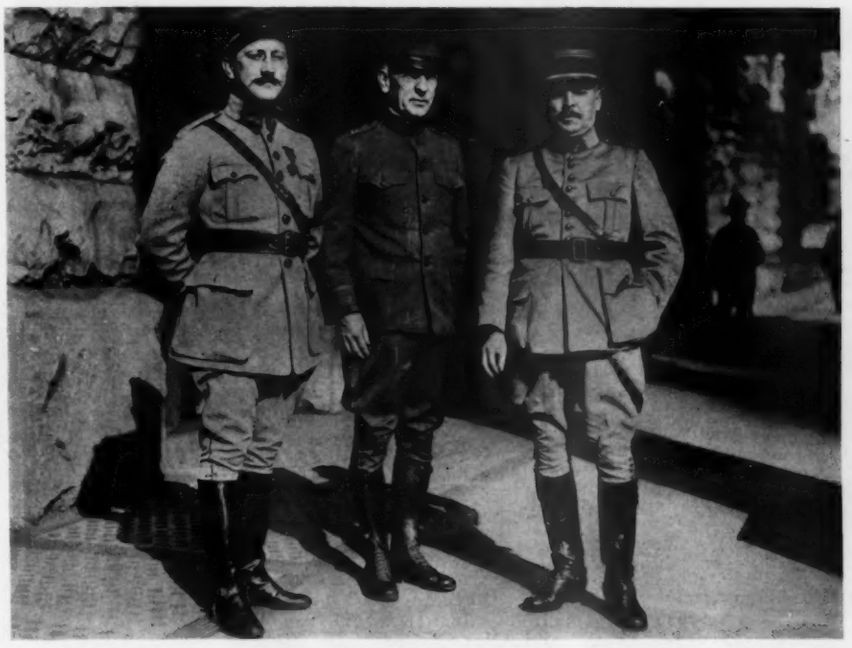
Foundrymen Stage Big Win-the-War Convention

Patriotic Work of Tangible Value Accomplished at Big Allied Metals Congress in Milwaukee—Semisteel Shell Manufacture Discussed

FROM the stirring resolution telegraphed to President Wilson on Tuesday morning, through the annual banquet Thursday evening with its splendid patriotic addresses to the concluding session Friday morning, the great convention held in Milwaukee during the week of Oct. 7 under the auspices of the American Foundrymen's association, the American Institute of Mining Engineers and the American Malleable Castings association displayed a singleness of purpose and consistency of action fully in harmony with the grave necessities of the days through which the United States and its allies are now passing. In everyone's mind at Milwaukee was this one question—"How can we contribute more effectively to the winning of the war and to the abject and crushing defeat of German plans for world-wide tyranny?" Unofficially, but nevertheless aptly named the Allied Metals Congress, the Milwaukee foundry convention will go down in history as the unconditional surrender meeting of 1918. The win-the-war spirit was evident at every session, and reflected in every exhibit on the two floors of the great Milwaukee auditorium. This spirit found its most telling expression early in the week in the resolution already referred to. This resolution was adopted jointly through a unanimous rising vote by the American Foundrymen's association, the American Institute of Mining Engineers and the American Malleable Castings association. The complete text of the resolution is published on the following page. It pledges every resource of the allied metal trades to the government, not only for the production of materials for the conduct of the war, but for the accelerated manufacture of such materials in order to enable the government to bring about a speedy and crushing defeat of the enemy which will result finally in his abject and unconditional surrender. Tangible impetus was given this splendid resolution at every session throughout the week, and particularly at the great semisteel shell meeting on Thursday afternoon. This meeting was added to the regular program after the convention started at the request of the ordnance department in order to acquaint foundrymen with some of the details of the government's far-reaching plans for the



THE PRESENCE OF DISTINGUISHED FRENCH OFFICERS GAVE INTERNATIONAL COLOR TO THE CONVENTION

From left to right—Lieutenant Laurent of the French Technical Mission; Capt. O. C. Hall of the United States Army Ordnance Department; Capt. Guillemin of the French Technical Mission, in charge of the French Officers assigned to the Milwaukee convention.

AFTER THE STEEL SESSION

R. H. Bourne (left), Whiting Foundry Equipment Co., Harvey, Ill., and C. R. Messinger, Sivyer Steel Casting Co., Milwaukee

manufacture of millions of semisteel projectiles. This session made it clear that the ordnance department can count on the effective co-operation of the entire foundry industry. An international flavor was added to the semisteel shell meeting through the presence of distinguished members of the French Technical Mission, who came to Milwaukee specially to co-operate with American foundrymen interested in semisteel shell manufacture.

Equally important from the standpoint of winning the war, were the remarkable feature films shown by Maj. Frank B. Gilbreth of Providence, R. I. These films were made under the supervision of the army general staff at the Fort Sill school of arms for the purpose of instructing American soldiers and army mechanics. They demonstrated a new method of transferring skill which seems destined to have far-reaching results. Films were shown illustrating the construction and operation of rifle grenades, trench mortars, machine guns, etc. These moving pictures included phantom or sectional drawings which vividly illustrated the actual working of the internal mechanisms of bombs, grenades, etc.

A Stimulating Message

The unconditional surrender spirit which dominated the whole convention found further expression at the opening joint session on Tuesday morning on the occasion of the reading of a message from the western front by Capt. R. A. Bull, past president of the American Foundrymen's association. Captain Bull's masterly letter was received with tremendous applause, and was in fact the inspiration for the resolution telegraphed to the President.

Further light of a practical character was shed on the problems of ordnance manufacture at the steel session on Thursday morning at which the production of ordnance steel castings to government specifications was discussed with unusual thoroughness. This session was one of five held on Thursday, four of which took place simultaneously Thursday morning. The necessity for such an unusually large number of simultaneous sessions demonstrates clearly the tremendous scope of the convention and the great volume of work accomplished. The latter also may be measured from the fact that there were 53 titles on the program of the American Foundrymen's association alone, with 20 more on that of the Institute of Metals division of the American Institute of Mining Engineers, and 12 on that of the Iron and Steel section of the American Institute of Mining Engineers, making a grand total of 85 papers, reports and addresses presented to the convention during the week. A large number of these papers have to do directly with war-time production problems. Among these may be mentioned especially the following: "Engineers—Their Relation to the Foundry in the Saving of Labor," by E. S. Carman; "Sale and Distribution of Foundry Pig Iron in War Times," by C. J. Stark; "Activities of the Army Ordnance Department, Especially as Applied to Foundry Matters," by C. S. Koch; "Women in the Foundry," by C. E. Knoeppel; "Ordnance Steel for the Army and Navy," by John Howe Hall; "Meeting Specifications for Army Ordnance Steel Castings," by Capt. E. R. Swanson; "The Commerce of Coke," by J. A. Galligan; a symposium on "The Conservation of Tin," "The Work of the National Research Council," by Dr. Henry M. Howe; "Notes on Certain Iron Ore Resources of the World," "The By-Product Coke Oven and Its Products," by W. H. Blauvelt; and "Price Fixing of Bituminous Coal by the United States Fuel Administration," by Cyrus Garnsey.

Urge Unconditional Surrender

LEADERS in the American iron and steel industry pledged all their united resources to the complete overthrow of German military power at the opening session of the Allied Metals congress at Milwaukee. Great applause was given to a resolution placing this pledge before President Wilson, the resolution being given unanimous approval. The resolution follows:

Hon. Woodrow Wilson,
President of the United States,
Executive Mansion,
Washington, D. C.

Resolved by the American Foundrymen's association, the Institute of Metals division of the American Institute of Mining Engineers, the Iron and Steel section of the American Institute of Mining Engineers, the American Malleable Castings association and the foundry equipment manufacturers of the United States in joint meeting assembled,

That every resource of these allied metal trades is again pledged to the government not only in the production of materials for the conduct of the war, but for the accelerated manufacture of these materials to enable the government to greatly intensify its prosecution of the war and to bring about a speedy and crushing defeat of the enemy that will lead to his abject and unconditional surrender.

Schwab Brings Cheers

The convention reached its climax at the annual banquet Thursday evening which was characterized by three splendid war-time addresses by Maj. Radclyffe Dugmore, W. H. Blood Jr., and Charles M. Schwab, respectively. Mr. Schwab's statement that the submarine menace is a thing of the past, was received with tremendous enthusiasm.

It was the first convention at which an entire session was devoted to the consideration of safety problems and in this connection the reclamation of crippled soldiers received due attention. As a result of the meeting in Milwaukee, also, a war service committee of foundry equipment manufacturers was organized for the purpose of co-operating with the war industries board. The registration of members of the allied societies exceeded all previous records, totaling 1056 for the three associations, including 771 members of the American Foundrymen's association. In addition, several thousand foundrymen and

LOOKING FOR THE FRENCH OFFICERS

G. Muntz, Tropenas Converter Co., New York, had the somewhat unique distinction of being able to converse with the French officers in their own native tongue

C. E. HOYT
Secretary-Treasurer, American Foundrymen's Association

New Officers of American Foundrymen's Association

President:
A. O. BACKERT,
The Penton Publishing Co.,
Cleveland.

Vice President:
W. A. JANSSEN,
Canadian Steel Foundries, Ltd.,
Montreal.

Secretary-Treasurer:
C. E. HOYT,
Chicago.

Directors

(In addition to the above)

H. R. Atwater, Cleveland-Osborn Mfg. Co., Cleveland.
W. R. Bean, Eastern Malleable Iron Works, Naugatuck, Conn.
Capt. R. A. Bull, American Expeditionary Forces, France.
Henry A. Carpenter, General Fire Extinguisher Co., Providence, R. I.
H. E. Diller, General Electric Co., Erie, Pa.
Alfred E. Howell, Phillips & Buttorff Mfg. Co., Nashville, Tenn.
S. T. Johnston, S. Obermayer Co., Chicago, Ill.
C. S. Koch, Fort Pitt Steel Castings Co., McKeesport, Pa.
W. G. Kranz, National Malleable Castings Co., Cleveland.
C. R. Messinger, Sivyer Steel Casting Co., Milwaukee.
V. E. Minich, Sand Mixing Machine Co., New York.
J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.
H. B. Swan, Cadillac Motor Car Co., Detroit.

W. A. JANSSEN
Vice President, American Foundrymen's Association

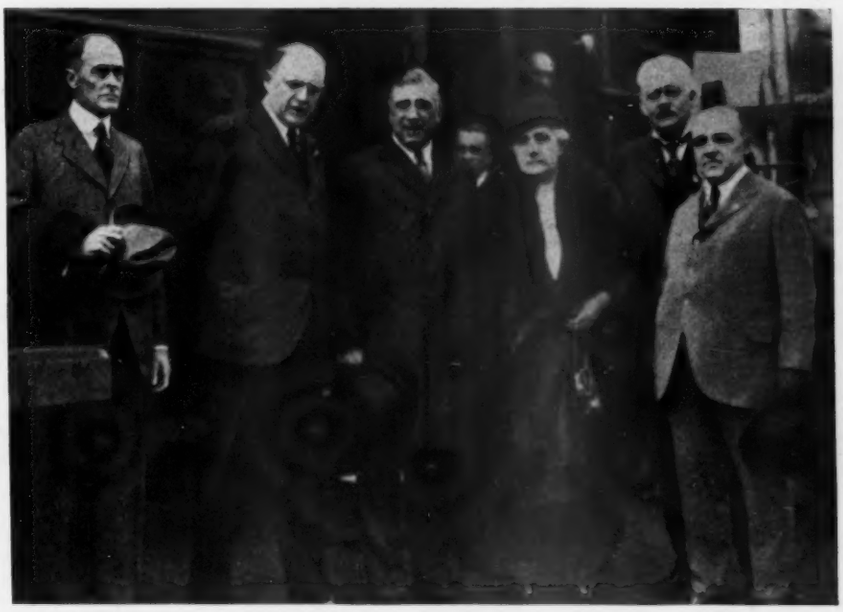
other manufacturers not affiliated with these organizations, also were in attendance.

The thirteenth annual foundry and machine exhibition which occupied the entire floor space of the spacious new Milwaukee auditorium during the whole week of the convention, is fully described on the following pages. In brief it was a great war exhibition and its importance fully justifies the attendance of the large number of prominent manufacturers, army officers and government officials who came to Milwaukee. The spirit of the 1918 exhibition was not a commercial one. Rather it was dedicated to service—service first to the industry, and through it to the nation in its great struggle for freedom and humanity.

The joint opening session of the different organizations co-operating in the Allied Metals congress was held on Tuesday, Oct. 8, at 10 a. m., in Plankinton hall, Milwaukee auditorium. Following this meeting, the different societies including the American Foundrymen's association, and the Institute of Metals division and the Iron and Steel section of the American Institute of Mining Engineers, began the week's program of individual technical sessions. Benjamin D. Fuller, president of the American Foundrymen's association, presided at the joint opening meeting. Gov. Emanuel L. Philipp of Wisconsin welcomed the visitors. He praised the efficient and patriotic assistance which the metal industries have extended and are extending to the government in the prosecution of the war. The manufacturers, he felt, should be given full credit for their efforts in quickly transforming their plants to a war basis. He predicted a period of continued prosperity after the war, based on demands for replacements and expansions. He urged all manufacturers to awaken to the possibilities offered by the growth of the new American merchant marine.

Mr. Fuller, in his response, sounded the keynote which dominated the entire convention—how to promote production in order to hasten victory in the war. He regarded the convention essentially as a meeting place for the acquisition and interchange of knowledge regarding methods of production, so that the full force of the foundry industry can be brought into effective play.

E. B. Brigham, manager iron ore, coal and grain traffic, United States railroad administration, Duluth, was unable to be present but a paper sent to the meeting by special messenger was read. Under the supervision of Director General McAdoo, Mr. Brigham promised that the transportation congestion which seriously hampered industries last winter would not be repeated this year. He said that the freight movement has materially improved by methods of operation put into service by the government and a sufficient supply of coal to all is now fully assured. Major Frank B. Gilbreth, Providence, R. I., delivered an ad-



CHARLES M. SCHWAB, DIRECTOR GENERAL OF THE EMERGENCY FLEET CORPORATION, RECEIVED A ROYAL WELCOME AT MILWAUKEE

From left to right: Clement C. Smith, Chairman, Baltimore Dry Docks & Shipbuilding Co.; John A. Penton, President, The Penton Publishing Co.; Mr. Schwab; Mrs. Schwab; Theodore Vilter, Chairman Milwaukee Local Committee; and A. O. Backert, President, American Foundrymen's Association.

FROM THE FAR FLUNG PACIFIC COAST
Prominent visitors attended the Milwaukee convention and exhibition from all parts of the world

dress on what he designated as modern methods of transferring skill illustrated with moving pictures. This modern method involves the use of the educational films to teach shop practice. To prove the simplicity and the accuracy of this method of teaching, Major Gilbreth exhibited films that had been made under the direction of the general staff of the army, showing the best method of stripping and assembling a Browning machine gun. This film is used to instruct soldiers and mechanics in the American army, many of the views being taken with a cross-section table as a background to illustrate the better the placing of the parts in sequence.

This film was followed by an illustration of an American soldier firing the gun, disclosing the proper methods of handling and repairing the gun in the field. Another film showed the construction and the proper method of handling the rifle grenade and of the trench mortar. In these films the photographs were faded into line drawings for the more detailed showing of the parts.

Major Gilbreth declared that if this method of instructing mechanics in the better handling of their tools and in the accomplishment of their work were universally adopted, the savings would be tremendous. Many persons attend conventions and steal one-half of the wrong ideas of others, whereas if moving pictures disclosing the proper methods were used and these lessons profited by, over $20,000,000 per day would be saved as a result of improved shop practice.

"There is today, as never before," said Major Gilbreth, "an all important need for increasing productivity. This demand is especially keen along the line of war necessities, in which everyone of you here assembled is vitally interested. Where the labor required is unskilled, untrained men may be turned to. Where, however, the product requires skilled labor, the problem is entirely different.

"The fundamental necessity is an increase in skill. This means creating additional skill where little or none exists; it means also fostering and developing such skill as does exist, and utilizing expertness not only directly, to produce products, but indirectly, to produce skill itself."

The films displayed by Major Gilbreth illustrated how the army is today training soldiers in the proper handling of small arms, and also training mechanics in caring for these same arms. The system now employed in the army where the training must be intensive, rapid and correct, could with great profit, be applied to practically every branch of the iron and steel industry.

"Military films," continued Major Gilbreth, "serve as significant illustrations, in that the necessity for increased skill among our war forces is vital and pressing; in that those to be educated possess a wide range of varying qualifications and differing experiences, and in that military activity goes back to prehistoric ages and furnishes a fertile field for comparative investigations. These new methods of transferring skill—derived in the industries—have proved themselves efficient in military training. Therefore no higher recommendation is needed for their application in any new field that may arise in industry."

C. E. Hoyt

CHARLES E. HOYT, who was elected secretary-treasurer of the American Foundrymen's association, Inc., has had a wide experience in association work and therefore is unusually well qualified to fill the position for which he has been chosen. Mr. Hoyt experience in foundry work was obtained immediately after leaving high school and subsequently he was appointed instructor in foundry and pattern shop practice at the Michigan Agricultural college. He remained with this institution for 3½ years and in 1899 *was appointed to a similar position with the Lewis Institute, Chicago. In* 1906 *Mr. Hoyt was elected secretary of the Chicago Foundrymen's club and in* 1908, *at Toronto, he was elected secretary of the Associated Foundry Foremen. In* 1909 *he was elected secretary of the Foundry Supply association, and in* 1911, *when this organization was succeeded by the Foundry and Machine Exhibition Co., he was elected secretary. When the exhibition feature of its annual conventions was taken over by the American Foundrymen's association in* 1916, *Mr. Hoyt was appointed manager of exhibits and he served in that capacity at the Cleveland, Boston and Milwaukee shows. Mr. Hoyt also was secretary of the war service committee of the American Foundrymen's association and was in charge of its activities at Washington during the first half of this year.*

Tuesday Morning Session

At the opening individual session of the American Foundrymen's association, held immediately after the joint meeting, Mr. Fuller gave the annual presidential address, which is published in full in this issue. He referred to the difficulties under which the foundry trade has operated, to the splendid assistance foundrymen have given to the government, and to the increasing demands which federal needs are making upon casting plants.

The board of directors in its annual report pointed out the activities of the war service committee which had headquarters at Washington for a number of months, and also outlined the work done on the standard cost system for foundries. The war service committee, it was stated, "had received a greater amount of recognition by the government than any other. Officers of the ordnance department have frequently called upon the committee for suggestions, advice and information." The directors during the year decided to offer the benefits of the standard cost system to nonmembers of the association at a slightly increased rate.

The directors' report also covered the activities of the exhibition committee which had charge of the Boston show. Complete receipts from Nov. 1, 1916 to Dec. 24, 1917, were $38,272.73, space rentals furnishing the bulk with $23,450. Expenditures amounted to $28,913.22, the principal items being administration, $6367.40; power, $6123.92; building rental, $3675; net cost of booth and decorations, $3078.97.

Membership at Top Notch

The secretary-treasurer in his annual report showed that the membership of the association was now the highest in its history. The total enrollment on June 30 was 1072, a gain of 55, or more than 5 per cent during the past year. He recommended an increase in the annual dues from $10 to $12 per annum. The increase was urged as necessary in putting the organization in condition to handle its essential activities. The report showed that the association received $18,804.89 during the year, disbursements being $18,711.09.

The Tuesday morning session closed with the appointment of the nominating committee and the committee on resolutions. The nominating committee was headed by Maj. L. L.

Anthes, Anthes Foundry, Ltd., Toronto, Ont. Other members were: A. E. Howell, Phillips & Buttorff Mfg. Co., Nashville, Tenn.; V. E. Minich, Sand Mixing Machine Co., New York; S. T. Johnston, S. Obermayer Co., Chicago, and W. A. Janssen, Canadian Steel Foundries, Ltd., Montreal, Que.

The chairman of the committee on resolutions was John A. Penton, Penton Publishing Co., Cleveland. Additional members were C. R. Messinger, Sivyer Steel Casting Co., Milwaukee, and A. E. Howell, Phillips & Buttorff Mfg. Co., Nashville, Tenn.

E. N. Hurley, chairman, United States shipping board, addressed a letter to foundrymen in general requesting them to co-operate with the government in making the greatest use of the merchant marine now building by the Emergency Fleet corporation. To profit by the efforts now being expended it was suggested that a permanent committee representing the industry be appointed to study the best means of making use of the American merchant marine when the war is over. Mr. Hurley said that it is not the intention of the United States to take trade from any foreign country, but that we must prepare to transport our own over-seas freight and develop our foreign markets.

Saving Manpower In Foundries

Subjects of general interest to foundrymen were discussed at the general session held by the American Foundrymen's association on Wednesday morning. These included problems of sand-blast installations, the work of foundry enginers, women in the foundry, foundry dust problems, and the commerce of coke.

H. D. Gates, Pangborn Corp., Hagerstown, Md., presented a paper on "Selecting the Sand-Blast Equipment for the Foundry." In common with other discussions presented during the week, this paper disclosed the savings in manpower possible through the wider adoption of mechanical equipment. Conservation of labor has become a duty, Mr. Gates pointed out, and an efficient sand-blast installation offers possibilities of making this duty a financially profitable venture.

Fundamental considerations which should be given close attention by foundrymen in investigating sand-blast istallations were outlined. These include an intelligent understanding of what an efficiently planned system will accomplish and save. Each system should be laid out and designed to meet the conditions peculiar to the individual foundry if minimum costs of cleanings are to be obtained. This paper appears elsewhere in this issue.

"Engineers—Their Relation to the Foundry in the Saving of Labor," was discussed by E. S. Carman, Cleveland-Osborn Mfg. Co., Cleveland. He pointed out the tremendous waste of manpower involved in making castings on the floor which can be more readily and economically produced on molding machines. In order to bring about a clearer appreciation of this fact, the author urges the training of foundry engineers who are skilled in foundry practice as well as general engineering.

In an interesting analysis of the shipbuilding program, Mr. Carman showed that the production in 1919 of the 8,000,000 deadweight tons of shipping now practically assured, would require 933 tons of gray iron and 250 tons of steel castings daily. He estimated that 4650 hand molders would be kept continuously employed to handle this tonnage. If 75 per cent of the work is handled on molding machines, only 1200 molders would be required. The remaining 25 per cent would demand the labor of 1200 molders, a total of 2400 molders. The saving would thus be 2250 molders daily.

H. L. McKinnon, C. O. Bartlett & Snow Co., Cleveland, in discussing this paper pointed out the fallacy of wasting the time of engineers and draftsmen in perfecting designs for individual castings of which only a small number are required. He favored a greater analysis of designing problems, however, where large numbers of castings of the same type are to be made.

Employment is the factor that looms largest in the foundry industry, according to C. E. Knoeppel and M. J. House, C. E. Knoeppel & Co., New York, in a paper on "Women in the Foundry." In the absence of the authors, the paper was read by title only. On the basis of an army of 5,000,000 men, with 6½ persons working in industrial pursuits to maintain each soldier, the authors estimate that 32,500,000 persons must be transferred from peaceful activities to war work. Older men, boys and women must form the basis of much of this army. In enlisting the best service of the women, particularly in the foundry industry, the authors urge that proper working conditions be provided, that equal wages be paid for equal work and that the women be selected carefully and properly trained for their work. After an exhaustive analysis of women's new place in industry, the authors predict that "if the war is to end as we want it, then we must use women in industry."

H. D. Egbert, Research Corp., New York, discussed "The Cottrell Precipitation Process and Its Application to Foundry Dust Problem." Elec-

Hands Across the Sea

ASSURANCES that the United States is at last producing munitions, especially shell, in quantity, were first made known at the convention by capable authorities, the experts from France attached to the French Technical mission who have come to this country to advise us in technical details of production. The members of the mission present in Milwaukee included Captain Guillemin and Lieutenants Laurent and Blanchet. Wearing the Croix de Guerre, Lieutenant Laurent expressed admiration for the progress made by American manufacturers in turning out ammunition to drive the Huns out of France and Belgium. Captain Guillemin, head of the commission does not speak English. The two distinguished visitors were accompanied by Capt. O. C. Hall, of the American army. France, said Licutenant Laurent, began the production of semisteel shell some time ago. By using semisteel shell, he said, it is possible to put more plants at work and to use the small plants. The technical commissioners hope to co-ordinate the raw material resources of the United States to the military requirements. They were sent to the United States to deal with munition problems in general but especially with guns, carriages and shell. The semisteel shell problem, however, has until now occupied practically all of their time. He also mentioned the problems incident to the manufacture of artillery caterpillars.

AFTER THE MINING ENGINEERS' SESSION

At the left, Dr. Bradley Stoughton, secretary, American Institute of Mining Engineers; at the right, Professor J. W. Richards, chairman, Iron and Steel Committee, American Institute of Mining Engineers

THE "SAFETY FIRST" SMILE
Victor T. Noonan, Director of Safety, Ohio Industrial Commission, just after the Safety Session

trical precipitation is employed in collecting dust from sand-blast, tumbling barrels, grinding wheels, etc. Two sets of electrodes comprise the principal elements of the precipitat r. These are of opposite polarity and are shaped so that a silent or glow discharge is maintained between them by supplying the discharge electrode with high voltage direct current. In cleaning, the air or gas passes between these electrodes and the dust particles, becoming charged with static electricity, are assembled on the collecting electrode. Apparatus is employed for supplying the electrical current, for rapping the electrodes and for carrying away the dust.

Foundries will have enough coke for capacity operation this winter, according to J. A. Galligan, Pickands, Brown & Co., Chicago, who discussed "The Commerce of Coke." He pointed out that the conservation of transportation is one of the business practices developed under the stress of war conditions which will be carried over into the days of peace. He urged that foundries make particular efforts to secure their coke from the nearest plants, a step which would not only save transportation but would reduce the liability of delays. He traced in his paper the development of the by-product coke industry.

"About 100,000,000 more tons of coal will be required this year than last," said Mr. Galligan. "Increased production will supply half of this, the remainder coming from a saving of 35,000,000 tons by industries and 15,000,000 tons by homes. Foundrymen can realize the volume of the coal traffic by recalling that an average 8-day coal movement equals a season's grain movement: a 32-hour coal movement equals a season's cotton movement. The coal dug annually equals the excavation involved in 2¼ canals the size of the Panama canal, the coal being carried an average of 300 miles."

In the discussion of foundry costs following the presentation of the report of the association's committee on costs, numerous incidents were cited by an expert accountant of the failure of various foundries to employ even the simplest of cost systems. A plea for better and standardized cost-keeping methods was made in order to avoid a *post bellum* condition in which American foundries, with high labor costs, would be unable to sell outside this country. The number of subscribers to the association's standard cost system has increased to 117.

Session on Safety and Sanitation

When a workman meets with an accident to an eye, not only the industry in which he is employed, but also the nation, has been limited by the loss of one eye. This frank statement of the fundamental principle underlying all accident prevention work was made by Victor T. Noonan, director of safety, industrial commission of Ohio, Columbus, O., presiding at the session on safety and accident prevention. He added that casualties in American industries today are equal to the casualties sustained by an army of 2,700,000 men fighting under modern conditions in the front trenches. Statistics prepared by the state of Ohio show that the accidents occur chiefly to men between the ages of 21 to 41, within the draft age. This is a matter which, it was agreed, demands serious attention especially during war times.

The proposed sanitation code, prepared by the committee on safety, sanitation and fire prevention, relating primarily to safeguards for the health of workmen, was adopted and a tentative code on fire prevention also submitted by the committee, was deferred for further study. A more comprehensive code on fire prevention will be presented at the next annual convention. A paper entitled "The Personal Interest of the Employer is Necessary in Accident Prevention," by Mr. Noonan, was read by title, as was also a paper by Mr. Noonan on "The Vital Importance of Industrial Accident Prevention in War Times." A paper on, "An Accident Prevention Campaign in an Open-Hearth Steel Foundry with the Aid of Safety Committees," by F. G. Bennett, director of safety, Buckeye Steel Castings Co., Columbus, O., and one on "Safety and Efficiency Facts and Figures," by C. W. Price, field secretary, national safety council, Chicago, were presented by Mr. Noonan, Messrs. Bennett and Price being unable to attend the meeting.

More Casualty Figures

IN the United States right now there are 38,000,000 *wage earners and out of that* 38,000,000 *wage earners every* 12 *months—every* 365 *days—there are* 25,000 *wage earners killed by industrial accidents; that is* 83 *wage earners killed every day;* 83 *killed yesterday,* 83 *will be killed today. A trench nine miles and a half long, and in the bottom of that trench a solid sidewalk of human bodies every year in the United States as the result of industrial accidents. There are* 70,000 *wage earners that are annually so seriously injured that they lose over four weeks of time,* 2333 *each working day."—C. W. Price, national safety council, Chicago.*

THE BOSTON HUSTLE
R. F. Harrington, Hunt-Spiller Mfg. Co., Boston, smiling over a new joke about the AC3 point

Fred M. Wilcox, vice president, industrial commission of Wisconsin, Madison, Wis., recounted some of the advantages obtained by both employer and employe from the adoption of safety appliances and methods. Mr. Wilcox said that the accidents in Wisconsin during one year remove enough employes to equip three plants the size of that of the Allis-Chalmers Mfg. Co. at Milwaukee. Accidents, he pointed out, occur chiefly to new men, and during the winter months when it is necessary to use artificial light. Machine accidents can be prevented largely with the use of safety appliances, but it is necessary that the personal element exist between the employer and employe if accidents due to other causes are to be prevented. Mr. Wilcox thought that safety instructions and orders should be addressed to the

superintendents and the foremen rather than directly to the workmen and these supervisors instructed to obey and see that their men obey the rules.

In concluding, Mr. Wilcox said that Ohio is possibly the most liberal state in the Union as regards industrial liability protection. Ohio gives more protection to the employer and the employe than any other state.

Before closing the session Mr. Noonan announced that the bureau of standards, Washington, has signified its intention of standardizing industrial codes. It is intended to take the code of the American Foundrymen's association as a basis for a standard foundry code to be applied in each state.

Pig Iron Shortage to Continue

The pig iron situation which the foundry industry is facing at the present time was analyzed by C. J. Stark, editor, *The Iron Trade Review*, in his paper, "Sale and Distribution of Foundry Iron Under War Conditions", which was presented at the gray-iron session Thursday morning. This paper is published in full in this issue. Mr. Stark prefaced his paper by the statement that statistics of pig iron production for the month of September just compiled by *The Iron Trade Review*, showed the largest total of any 30-day period in the history of the country and that the daily rate of output also was at the highest rate on record. It was indicated that October, the month when operating conditions usually are the most favorable, would break all monthly records. While this showing was very encouraging and reflected the intensive efforts being made by the government and the furnaces to overcome obstacles to production, it holds out no promise that the shortage of iron with which the country is suffering will be retrieved at an early date. In fact this shortage promises to continue indefinitely.

Prof. W. Trinks of the Carnegie Institute of Technology presented "The Use of Positive Displacement Blowers in Cupola Practice." Other papers presented by title were "The Continuous Two-Story Foundry," by J. F. Ervin, Michigan Motor Castings Operating Co., Flint, Mich.; "Organizing a Foundry for the Economical Production of Gray Iron Castings," by Paul R. Ramp, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.; "Recent Developments in Burning Oil in Cupolas," by John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.; "A Rapid Method for the Determination of Graphitic Carbon," by Frank H. Kingdon, Sullivan Machinery Co., Claremont, N. H.

R. S. Macpherran, Allis-Chalmers Mfg. Co., Milwaukee, chairman of the subcommittee on steam and hydraulic castings, presented a tentative draft of proposed standard specifications. This work is to be continued during the present year.

President Fuller referred to the tragic death of W. J. Keep at Detroit and briefly spoke of the great service which the latter had rendered to the foundry industry. He commented upon the coincidence in the circumstances surrounding the death of Mr. Keep and of Thomas D. West, both prominent figures in promoting scientific practices.

Over five hundred banqueters were moved to a high pitch of enthusiasm on Thursday night by Charles M. Schwab, director general of the Emergency Fleet corporation. Several hundred persons, unable to obtain seats at the banquet table swarmed the corridors until near midnight to listen to Mr. Schwab. Maj. A. Radclyffe Dugmore, of the British army, and W. H. Blood, Jr., assistant to the president, American International Shipbuilding Corp., also made addresses relating to war work.

Mr. Schwab said that within the past 90 days the Emergency Fleet corporation had placed in service 1,000,000 deadweight tons of new merchant ships, and that during October it is expected to place 400,000 tons more in service. Prior to last year the largest annual production of ships in American yards was 400,000 tons. By spring, Mr. Schwab said, the American yards will be delivering ships at the rate of 700,000 deadweight tons a month, that is, ships completely equipped and ready for service.

The great iron master made brief mention of the work he had been doing at Bethlehem, from which he withdrew all active connection when he went with the shipping board. Bethlehem, he said, has a pay-roll of $5,000,000 a week, and during the first year of the war shipped as many shell to Europe as all England produced.

With the use of illustrated slides Major Dugmore gave a summary of what England is doing in this war. The immense preparations made for the first Somme offensive, the large number of men lost, and the great demands made to carry on the war, he pointed out, should discourage workmen at home from going on strikes while this emergency lasts. A striker during war times, he declared, is a murderer, who is prompted to strike either because he is ignorant of conditions on the front or because he is most decidedly pro-German.

THE WONDERS OF SEMISTEEL

David McLain, on the right, expounding the virtues of scientific melting to a fellow foundryman

Mr. Blood used slides and moving pictures to illustrate the immensity of the engineering job in connection with the building of the Hog Island shipyard. In all England there are but 209 ways whereas in the Hog Island yard there are 50 ways alone for building ships. It has contracts to build 180 ships, and it is expected that the yard will have been constructed and all these ships completed within 24 months from the date of breaking land on Sept. 15, 1917. Three ships have already been launched from the Hog Island yards, and one of them will have been equipped and delivered within the next few days. Forty other ships are now on the ways.

The Final Session

At the concluding session on Friday, questions relating to sand and pouring were discussed in considerable detail. A paper by Henry B. Hanley, New London Ship & Engine Co., Groton, Conn., describing an effective means of improving the quality of foundry sand mixtures, was read. Several slides illustrating methods of analysis and mixing together with microscopic views of the sands in the various stages of the mixing process were shown.

Mr. Fuller presented the report of the committee advisory to the United States bureau of standards, which was appointed to co-operate with the government in fixing standards for molding sand. He said that the war has interfered with the work of the committee and it was recommended that it be continued and instructed to report at the next convention of the association.

The resolutions committee reported and the convention adopted a resolution of thanks to the Milwaukee chamber of commerce. Proper recognition was taken of S. Griswold Flagg, III, vice president of the association, who resigned to enter the government service, and also resolutions of regret over the death of W. J. Keep, the noted expert in foundry practice were adopted by rising votes.

In accordance with the time honored custom, the new officers of the American Foundrymen's association were formally installed at the final session. These officers, who were elected by the unanimous vote of the board of directors are: A. O. Backert, The Penton Publishing Co., Cleveland, president; W. A. Janssen, Canadian Steel Foundries, Ltd., Montreal, vice president; C. E. Hoyt, Chicago, secretary-treasurer.

After the new officers of the association were installed it was unanimously agreed to place the name of the retiring president, Mr. Fuller, who has also recently retired from the foundry business, upon the list of honorary members.

Headed by Theodore O. Vilter, chairman of the executive committee, the various local entertainment committees provided several enjoyable occasions for the visiting ladies. Tuesday afternoon automobiles were furnished by Milwaukee citizens and the guests were conducted on a tour in

and about the city. Tuesday evening a reception and dance was held in one of the spacious halls of the auditorium. Wednesday noon, the ladies were tendered a luncheon and Wednesday night, the entire Majestic vaudeville theater was reserved for the visiting delegates and guests. Thursday afternoon completed the schedule of entertainment provided by the local committee, when a card party and tea for the ladies was held in the Badger room of the Hotel Wisconsin. According to the custom of the past years, the ladies attended the annual banquet.

New Light on Ordnance Steel Problems

THE active interest taken by foundrymen in ordnance steel problems was shown clearly by the splendid attendance at the steel session held Thursday morning, at which various phases of ordnance manufacture were discussed. C. R. Messinger, of the Sivyer Steel Casting Co., Milwaukee, was chairman.

Discussion of ordnance steel manufacture was introduced by the presentation of two papers, "Ordnance Steel for the Army and Navy," by John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J., and "Meeting Specifications for Army Ordnance Steel Castings," by Capt. E. R. Swanson, ordnance department, inspection division, Washington.

At the convention a year ago, ordnance steel manufacture was comparatively new to many foundrymen and the subject was being approached in an experimental manner. At the meeting at Milwaukee, the discussions were participated in actively, by the large number of foundrymen present who had successfully mastered the problem during the previous year, thus affording opportunity for recitals of actual experiences.

Captain Swanson's and Mr. Hall's paper are presented in this issue. C. S. Koch, Fort Pitt Steel Castings Co., McKeesport, Pa., stated that the annealing problem has proved most troublesome to foundrymen. Close attention in providing the correct equipment is essential. The ordnance department considered the establishment of set rules for annealing but decided against this plan owing to the wide variety of equipment. "A good annealer," said Mr. Koch, "is just as essential as a good chemist."

Steel of either No. 2 or No. 3 grades can be made by the open-hearth, electric, converter or crucible process, Mr. Koch pointed out. Some converter foundries had not thought this possible. He explained that from his experience he believed an electric steel foundry and a converter foundry are making the best records of any casting plants in the country engaged in ordnance steel production. This results more from the manner in which these foundries are managed than from any inherent advantages in these processes. Few open-hearth plants are at work on government steel. Converter foundries found some difficulties before army specifications were changed, unless they were assured of good coke.

Double Annealing Suggested

T. S. Quinn, Lebanon Steel Foundry, Lebanon, Pa., in discussing the practice at his plant, stated that only electric steel is being made. Accurate pyrometric control is maintained. In starting work on ordnance steel, low carbon and high manganese stock was used and this plan is still in effect. Double annealing is employed, every heat being air quenched and drawn in order to avoid rejections. From 60 to 70 per cent of the plant's output is ordnance steel, and on an average not more than three heats are lost monthly on the first test.

C. Inglis, Milwaukee Steel Foundry Co., Milwaukee, explained that its practice formerly called for double annealing but in order to promote production, this was abandoned and equally good results are now obtained with only one anneal. The annealing temperature was 1525 degrees Fahr., the castings being cooled slowly in a closed furnace. Out of 2000 heats, he stated not more than six went back for retreatment.

I. Brejowski, production division, ordnance department, Washington, urged the importance of each foundry developing its own method, rather than for an electric steel foundry to endeavor to copy the practice of a converter plant. Mr. Koch in reply to a question, stated that it has not been demonstrated that an electric furnace must use higher carbon stock than a converter. Some electric steel plants use material running from 0.30 to 0.50 per cent carbon to secure No. 3 grade steel, while some converter plants use from 0.30 to 0.40 per cent carbon stock to obtain the same grade. In discussing ingotism, Captain Swanson stated that in annealing if the steel is brought beyond the critical point, all traces of ingotism would disappear.

In his own paper, Captain Swanson pointed out that the government's specifications for the three primary grades of ordnance steel correspond with those of the American Society for Testing Materials, except that greater latitude is given in the case of sulphur. He presented typical analyses of steels made in successful foundries. He urged the importance of controlling the analysis of the product and of suitable annealing equipment if satisfactory results are to be obtained.

Captain Swanson in the discussion pointed out that the best steeel castings are required and that the ordnance department cares only for results. In heat treating, the average foundry has had difficulties because the subject was imperfectly understood before the war. "Heat treatment," he said, "applied intelligently will work wonders. The foundry first must know is analyses. The best foundries are now installing new annealing facilities, and are providing intelligent supervision."

"Making Steel Castings on the Pacific Coast," was the title of a paper presented by J. D. Fenstermacher, Columbia Steel Co., San Francisco. He traced the development of the steel casting industry on the western coast and the problems peculiar to that district. Operations at the Columbia plant were described in THE FOUNDRY a year ago.

W. A. Janssen submitted the report of the committee on steel foundry standards, which has been investigating the technical considerations involved in the design of drying ovens and core ovens. Two papers on electric furnaces were read by title in the absence of the authors. These were "The Electric Furnace in the Steel Foundry," by W. E. Moore, W. E. Moore & Co., Pittsburgh, and "The Advantages of Basic Lining for Electric Furnaces," by F. J. Ryan, Electric Furnace Construction Co., Philadelphia.

Facts and Figures on Semisteel Shell Production

BEFORE what was undoubtedly the largest gathering of foundrymen ever held in America, the problems of semisteel shell production were discussed on Thursday afternoon by French and American ordnance officers. This session was arranged after the convention commenced on account of the tremendous interest in the subject of shell manufacture in foundries. John A. Penton, publisher of *The Iron Trade Review* and THE FOUNDRY, presided at the meeting in his capacity of chairman of the semisteel shell committee on manufacturing practice. In his opening remarks, Mr. Penton paid a glowing tribute to France for her wonderful work in the manufacture of artillery and munitions.

The technical features of the afternoon's program were opened by Captain H. M. Huxley, engineering division, ordnance department, Washington. Captain Huxley said the government expects to order several million semisteel shell ranging from 75 to 240-millimeters, or from about 3 inches to 9½ inches in diameter. The necessity for extreme care in the manufacture of semisteel projectiles was emphasized by Captain Huxley and the grave results which may follow the failure of a single shell were pointed out.

The French technical mission was represented at the meeting by Captain Guillemin and Lieutenants Laurent and Blanchet. Lieutenant Laurent read a prepared address dealing with the metallurgy of semisteel shell

on behalf of Captain Guillemin, who is unable to speak English. Lieutenant Laurent traced briefly the history of the semisteel shell. The superior fragmentation of semisteel as compared with cast iron was pointed out. Lieutenant Laurent also explained the principal features of the French specifications which provide for a tensile strength of 35,000 pounds per square inch and for a Brinnel indentation 4.25-millimeters in diameter made by a 10-millimeter ball subject to a pressure of 3000 kilograms for 30 seconds. The combined carbon in the mixture, said Lieutenant Laurent, should usually not be less than 20 per cent of the total carbon, and the silicon should be as low as consistent with suitable machining qualities. The emperical rule, total carbon plus silicon equals 4.50 per cent or less, should be observed in preparing the cupola mixture. Lieutenant Laurent also said that aluminum is used as a deoxidizer, not to exceed 0.01 per cent. Lieutenant Laurent recommended making the molds on jar ramming machines, explaining that in France the dry-sand process using a two or three-part flask is employed. The molding sand consists of two-thirds new sand and one-third old sand.

F. B. Howell, head of the research department of the American Radiator Co., now connected with the ordnance department in an important capacity, described the practice of the American Radiator Co. which is based on its extensive experience in its plants in England and France. Mr. Howell also showed a large number of lantern slides which thoroughly illustrated every detail of the molding process. He laid special emphasis on the necessity for taking great care in making the cores, since the success of the shell to a very large extent depends on the degree to which the core successfully performs its part. The shell are cast in one-part flasks in the green-sand molds, there usually being four shell in a flask, nose down, a drop-gate of the strainer type being employed. The flask and pattern equipment, Mr. Howell pointed out, should be made of cast iron specially and designed for the work in hand. The larger shell also may be cast in single flasks. A coarse, open, lightly bonded molding sand should be employed. The flask is not rolled over during the operation of making the mold and the ramming is effected on a plain jar-ramming machine. A dry-sand pouring basin takes the place of the cope, this basin containing a strain gate. The riser has the same diameter as the butt of the shell and a height equivalent to the diameter.

The dry-sand core is made on a steel arbor which fits accurately into a reamed hole in the bottom of the flask, the core being clamped securely by means of a nut on the end of the arbor. A split core box is used, the core being rammed endwise. This core box is made by means of a master core box, the working core boxes being unmachined except for the fitting surfaces.

A simple clamping device is provided for holding the two parts of the core box together while the core is being rammed up. The arbor passes through a machined hole, similar to that provided in the flask, and is clamped rigidly in place by a thumb nut. The core is rammed from one end by hand, using a very light wooden ramming stick, the rounded upper or rear end being formed by a detachable nosepiece which is fitted on the top of the box as one of the final operations in making the core. The box is provided with trunnions on which it may be swung into convenient positions for ramming and unclamping. The trunnions are supported by a wooden frame of special construction to permit of ease in handling.

The arbors are made of extra strong wrought-iron pipe, ½-inch pipe being employed for the 4.7-inch and 155-millimeter shell. For the latter the arbor has an overall length of 27 inches. The ferrule or seat portion which fits into the flask is 5¾ inches in length for 155-millimeter shell. The clamping nut works against a ½-inch collar. To provide for the escape of the gases when pouring the mold the arbor is drilled with 3/16-inch holes throughout its length. To keep the holes in the arbor from being plugged and to provide for its easy removal, the arbor is wrapped with strips of burlap about three inches wide.

The shell may be cleaned on the outside by tumbling, said Mr. Howell, although they are hard on tumbling mills. They also may be cleaned on the inside by means of a stiff wire cable, ⅝-inch in diameter, mounted vertically in a rapidly revolving spindle. This cable is whirled around the inside of the shell at a high rate of speed thus quickly removing the core sand.

The principal operations involved in machining the shell also were explained and illustrated by Mr. Howell, including centering, tapping, turning, banding, painting, etc. At the conclusion of the meeting, Captain Huxley answered questions put by the audience. He said that at present the government does not believe it is practicable to award semisteel shell contracts unless the contractor is in a position to handle 1000 shell per day, or in other words, to melt from 60 to 75 tons of metal. There might, however, be special exceptions, he stated, adding that it is the intention of the department to furnish as many foundrymen with orders as possible.

Discuss Metallurgy of Malleable Iron

ENRIQUE TOUCEDA, Albany, N. Y., pointed out why such a large number of malleable iron manufacturers were brought together at the malleable session in Milwaukee on Thursday morning. He said, "We are dealing with men who understand their business and it does not need a prophet to forecast that all ferrous products from now on are going to be measured under higher and higher standards of inspection. The malleable manufacturers understand this fact, and appreciate that the free exchange of ideas under conditions furnished by the Milwaukee meeting will afford the best means of improving their product." W. R. Bean, Eastern Malleable Iron Co., Naugatuck, Conn., presided in the absence of J. P. Pero, chairman.

H. A. Schwartz, National Malleable Castings Co., Indianapolis, presented a paper containing much valuable data of an engineering nature with reference to malleable iron. He outlined the early history of the manufacture of malleable and described the reactions which take place in the production of malleable castings. Graphic diagrams and microphotographs printed with the paper served to illustrate the features to which the author directed attention and in conclusion, a summary of characteristics which fit malleable iron to many engineering uses served to crystallize the thought of the entire paper. Dr. Richard Moldenke submitted a written discussion which was read in his absence. In this discussion the statement of Mr. Schwartz that the first chemical laboratory operated by a malleable foundry was established in 1903, was questioned. Dr. Moldenke told of investigations under laboratory control started in 1890. Mr. Schwartz said that previous laboratories were no doubt in existence, but the one noted in his paper was solely for the use of the malleable foundry to which it was attached, in other words, it was the first commercial laboratory in ordinary daily use.

Structural and chemical changes which take place in annealing malleable iron were set forth in a paper by H. E. Diller, General Electric Co., Erie, Pa. Experiments carried on in the research laboratories of the General Electric Co. were explained and conclusions relative to the time required by the annealing operations were mentioned. It is said in this paper that malleable iron may be annealed in a tunnel furnace in 48 hours or less. A written discussion by Phillip d'H. Dressler, American Dressler Tunnel Kilns, Inc., New York, describes a furnace similar to that referred to by Mr. Diller. In the open discussion, it was stated by Oliver W. Storey that packing materials have no effect on the structure of malleable iron. He mentioned some experiments in which brass was used as packing to prove this point. The effect of temperature and cooling, however, is marked. When cooled too rapidly from 1600 degrees to from 1200 to 1300 degrees Fahr. a hard steely structure results. W. R. Bean reported an experiment in which several bars or wedges were annealed for 48 hours at 1600 degrees Fahr. in a tunnel furnace used by a sheet mill. The specimens were put through the furnace without any surrounding packing, and the fractures, particularly of the wedges were gray, showing the graphite carbon.

Donald S. Barrows, the T. H. Symington Co., Rochester, N. Y., read an interesting descriptive paper, relative to a coreroom constructed to supply the needs of a malleable iron foundry which melts approximately 50,000 tons per year. In reply to questions, Mr. Barrows stated that the present coke consumption of the ovens which use this fuel is one ton of coke to 20 tons of sand.

The paper of J. G. Garrard, Northwestern Malleable Iron Co., Milwaukee, calls attention to the influence of proper gating, and packing in annealing. The regulation of top blast it was stated in the discussion, exercises little influence on the total fuel consumption.

Enrique Touceda, consulting engineer, Albany, N. Y., read a paper entitled "The Integrity of the Casting." This paper emphasizes the obligation of the malleable manufacturer to preserve the quality of his product for the ultimate good of the industry. Sponginess in certain sections should in no case be tolerated. Chills are deemed unnecessary by Mr. Touceda and the proper use of feeding heads is recommended as more satisfactory. The source of much trouble in malleable castings is stated to lie in the pattern. The paper says that each individual pattern should be studied by an expert to determine its fitness to make sound castings. In the discussion which followed this paper, the author said his opinion is that the method of making the metal mixture is not important; but that the proportion of materials in the mix is the governing factor. The report of the American Foundrymen's association committee on malleable castings, containing the malleable specifications which were prepared in co-operation with the American Society for Testing Materials was read by Mr. Touceda.

P. A. Paulson's paper, which was read in the absence of the author describes the fitness of malleable castings for agricultural machinery, and gives figures on the strength of malleable test specimens.

R. S. Archer, bureau of aircraft production, presented an exhaustive paper on annealing tests carried out at the University of Michigan. These tests were made by Mr. Archer and Major A. E. White with uniform samples of iron which analyzed 1.05 per cent silicon and 2.90 per cent carbon. Precautions were observed to preserve the carbon content unchanged. The slides which accompanied this paper illustrated the structural changes in micro-sections under different conditions of anneal. The authors condemn speeding up the heating during annealing, but state that the rate of cooling between the prescribed ranges is without metallurgical effect. It is said that the best temperatures to be used depend upon the varying chemical composition.

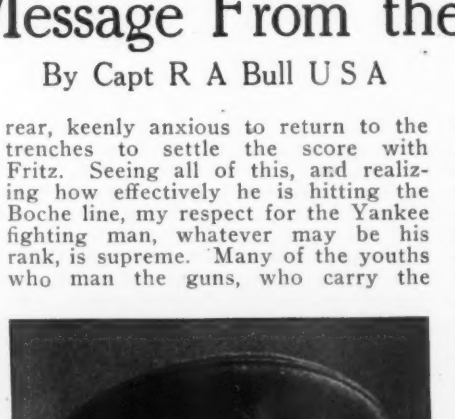
Foundryman's Message From the Western Front

By Capt R A Bull U S A

TO the members of the American Foundrymen's Association: The chairman of your committee on papers has written across the seas asking me to forward greetings appropriate for your convention to be held within a few weeks at Milwaukee. Your secretary has seconded the request. I am much indebted to both of these gentlemen for co-operation given me when the expanding activities of the association made heavy demands upon its officers, and I, therefore, find it difficult to refuse them. But my compliance is mainly due to a desire to testify to Uncle Sam's excellent care of his soldiers, and to add, if possible, to your pride in the morale of our fighting men.

If I occupied with the American expeditionary forces a position of exposure to dangers and hardships, or if I performed a relatively important function in the military organization in France, I would hesitate to voice my sentiments, which in either case might be mistaken for self-praise. At the outset let me confess that since arriving in France in May of this year, I have been a perfect stranger to unusual hazards of life and to physical discomforts.

Many things must be done by the noncombatant branches of the American army in France, back of the battle lines, in what is called the Service of Supplies. Those who are doing this work make no pretensions to performing the tasks of heroes, and feel the more keenly their great obligations to their comrades at the front, because of their own assignments in the rear. Many of them have seen, as I have, what a wreck of the yet living body can be made by the enemy's bullet, shell, bomb and gas; have witnessed the fortitude of wounded men under intense suffering; have observed the morale of our soldiers detained for treatment in the rear, keenly anxious to return to the trenches to settle the score with Fritz. Seeing all of this, and realizing how effectively he is hitting the Boche line, my respect for the Yankee fighting man, whatever may be his rank, is supreme. Many of the youths who man the guns, who carry the



CAPT. R. A. BULL

cold steel over the top, who bridge the streams under the enemy's fire, who minister to the wounded where they fall, are your own kinsmen. How proudly you must bear yourselves in the knowledge that those of your own flesh and blood are bearing this burden! And if perchance those whom you love, must make the supreme sacrifice, how glorious a heritage their dauntless courage will leave to you!

The things that are worse than death include subjection to Prussianism, with all the atrocities of which it is the parent. I have talked with some who witnessed the horrors perpetrated by the kaiser's minions upon the enslaved inhabitants of those sections of France and Belgium which for some time have been occupied by the enemy. I saw, in the critical days of the supreme effort made by the German army to capture Paris, the pitiable condition of old men, women and little children, fleeing from the wrath of the relentless Hun, carrying on their backs and in their arms all of their earthly possessions they could save. I cannot forget the expression of intense suffering on the faces of the women; of sorrow and bewilderment on those of the children, whose glances at every stranger seemed to ask the reason for it all. I have been proud of my nationality to learn how our own Red Cross has comforted many of those unhappy refugees. Every branch of the service has when possible taken a hand in relief work. One little boy has for some time called his home an American camp in the zone of advance where his fine, manly appearance in an olive-drab uniform drew my attention. I learned that U. S. engineer troops had discovered him at his daily task of getting subsistence from the camp garbage cans. Charlie was a homeless, friendless war waif of eight years. His father had been killed and his mother had died. He had been adopted by the engineers who found and left him in the efficient care of Y. M. C. A. representatives until the return from the front of his big-hearted foster-brothers.

It is always comforting to know that our own are in good hands. You have been informed through many channels that the American soldier in France is well cared for. I want to add my endorsement. The medical corps is zealous in its care for the sick and wounded, and in sanitary work. The strictest attention is given to drinking water. Troops quartered in barracks are housed with special

This letter was read at the opening session of the Milwaukee convention. Capt. Bull is with the A. E. F. in France.

regard for ventilation and cleanliness. In the camps in France where I have been stationed there are excellent bath houses, better than those at the camp in the states where I was formerly on duty. The quartermaster corps is rendering very efficient service in procuring and distributing clothing and other supplies. It sells tobacco and candies to the soldiers at very low prices. Twenty cigarettes of a popular American brand may be obtained for 5 cents. In most localities, and where conditions permit, the army messes have the most wholesome food, in liberal quantities, well prepared. There is no lack of sugar, wheat flour or meat in the American expeditionary force, mainly due, as we realize, to the cheerful self-denial of the folks back home. Just as rapidly as our troops arrive do their supplies seem to precede them.

The American Red Cross is surpassing all its magnificent traditions. It is found everywhere in France, seeking to serve, leaving with those who have felt its influence, grateful recollections that will never fade. Its chief function of caring for those selected by fate as the victims of the enemy's instruments of torture and suffering is being performed with the greatest skill and dispatch, in superb defiance of danger to those who minister. The inspiring devotion of its hard-working, consecrated men and women will constitute one of the most glorious memories of this conflict. Linked as its activities are with every patriotic home in America, its appeal to the sentiment of the Yankee in France makes it his ideal of devoted service that never fails.

The needs of the "Armee Americaine" have been thoughtfully considered apart from purely physical comforts. At the convalescent and rest camps every available means is supplied for cheerful, wholesome entertainment and recreation, with splendid effect on the spirit of the men. By long odds the greatest single factor in maintaining, day in and day out, the morale of the American soldier is the Y. M. C. A. There is the atmosphere of a democratic club, the resort of the finest type of man that has been created—the Yankee buck private. The nightly entertainments in the "Y" huts back of the line, the comforts in the advanced stations along the line, the single idea of service and the spirit of good cheer and clean living actuating this and similar organizations bridge the enormous gap between the home in America and the camp in France as no agency of different character could possibly do. The men and women who wear the red triangle have exhibited in many cases a heroic and, in general, a sympathetic spirit of helpfulness that makes an irresistible appeal. No mollycoddle tendency exists in the Y. M. C. A. in France to detract from its drawing power among red-blooded men. I have heard the "Y" leader at a Sunday night sing-song preceding a prayer and a soulful talk, conduct the singing of "Hail! Hail! the Gang's All Here. What the Hell De We Care Now?" with as much feeling as accompanied "Onward, Christian Soldiers", which followed it.

Some may wonder if the injunction to right living reaches the hearts of men whose business it is to kill Germans. I have a canteen picked up at the front, which once belonged to a doughboy who presumably made the great sacrifice. On the canteen are scratched the soldier's name and numerous characters including these words: "If a man ain't true to his wife how in Hell can he be true to his country?" That is the essence of fidelity to trust, domestic and public, which I believe to be one of the outstanding characteristics of your plain-spoken, tin-hatted representatives in France.

Mention of the spirit in your army overseas is incomplete without reference to the women at home. The typical American in France has created in his mind a halo about them. In his leisure hours he takes from the treasure-chest of his memory those American women who are especially dear to him, who are courageously keeping the home fires burning. Figuratively he places these heroines before him on the pedestals erected for them in his thoughts through the knowledge of their cheerful sacrifices. He sees them industriously making socks and bandages; conserving every grain of sugar and every ounce of flour; anxiously scanning the published casualty lists. He hears them praying to the Author of Liberty for the safety of him, its defender. And when he has received, as he invariably does from his mental journey home, the inspiration that no one now living in America can appreciate, he applies himself vigorously to the job of killing Huns with a solemn vow that *his* womenfolk, in this or any other generation, shall never suffer at the hands of war-mad Germany what has come to the women in France and Belgium.

They Who Bore the Brunt

Tribute has been paid to the splendid work of our allies countless times. Appreciation compels me to mention it at the risk of seeming to repeat something which needs no emphasis at my humble hands. I had the honor, a few days ago, to meet an elderly French general who has received 11 wounds in this war. One of them left an ugly scar on his chin, another a deep depression in his skull. His right arm is gone at the elbow. The general in fluent English, with the ardor of youth, discussed the war at length with a group of junior American officers. His analysis of conditions was keen. His praise of our troops was emphatic. His modesty and genuine friendliness were superb. This battle-scarred old veteran is still rendering valient service. His spirit is like that of the typical French soldier today. After four of the most trying years through which any nation could pass, the French maintain their poise and their vigor to a degree that is amazing. Unstinted praise is demanded by such an inspiring demonstration.

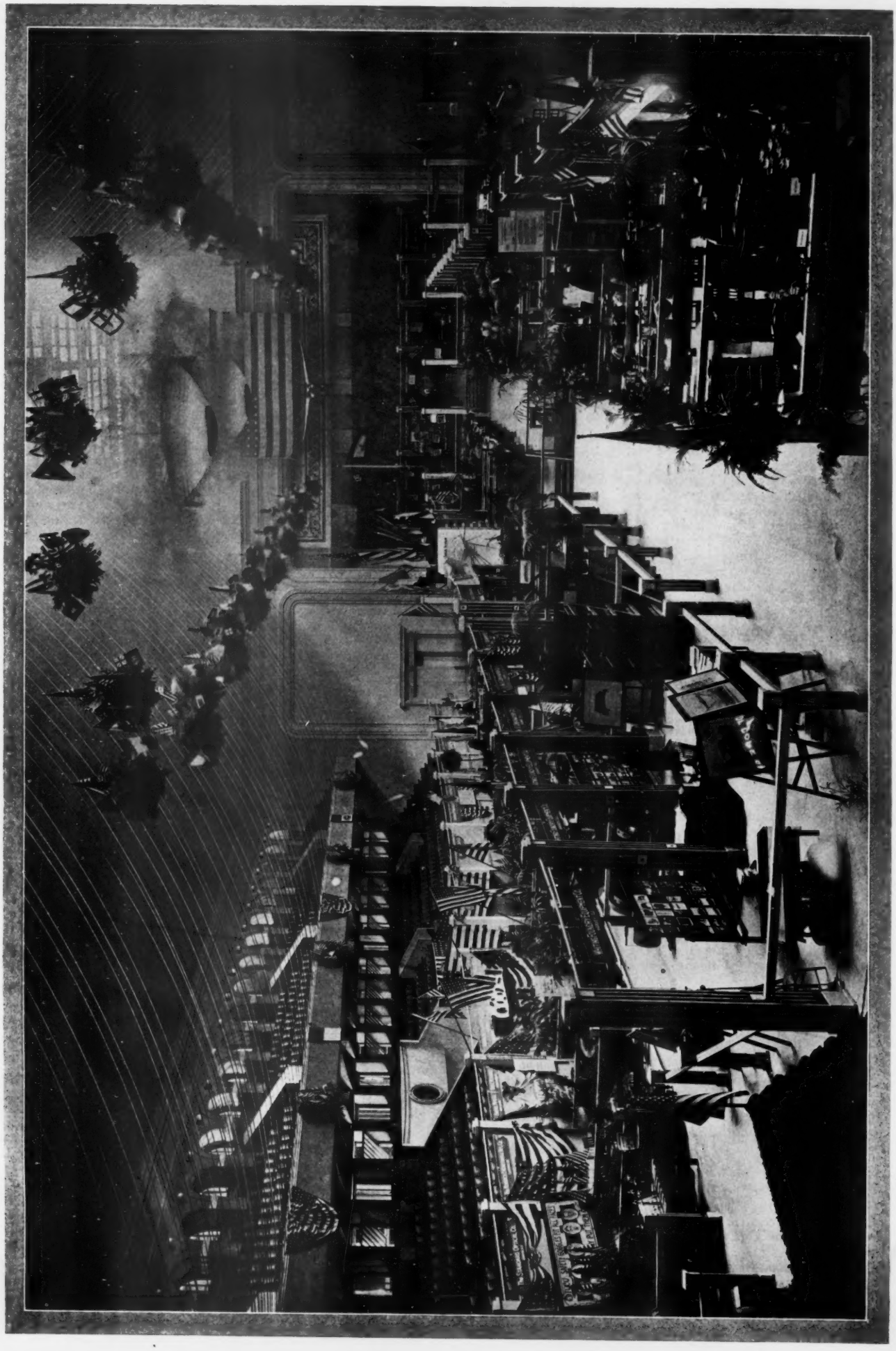
The British soldier is entitled to our admiration without bounds. He has been a complete failure—as his own press agent. As a tenacious, courageous bull-dog who quietly fights on until he or his adversary is done for, he merits our highest esteem. John Bull's allies are under an enormous obligation to these reticent chaps who went quickly from the British Isles and Colonies to the rescue of Belgium and France, and who, without any fuss, have been doggedly seeing the thing through. Do not forget the debt of America to the British navy. And remember that the British empire has to date furnished, according to press reports, about eight and one-half millions of her very best men to save democracy.

I can appropriately testify to the earnest appreciation of the men in the American expeditionary force for the splendid work being done by the industrial army in the states. Through the appreciated enterprise of certain journalists we receive daily European editions of several well-known American and English papers. From these and the admirable weekly paper of the American expeditionary force, called *The Stars and Stripes,* we are kept posted as to many developments concerning the war in our own native land. We see in France now many of the results of the labor at home. We know vastly more will follow as quickly as human ingenuity and untiring energy can bring them here. Your men in France are thrilled by the progress in shipbuilding, by the passage of the "man power" bill. Our location has not distorted our sense of perspective. We realize that millions of men and women and many children must labor in America that the vast numbers of her sons in Europe may have the means to furnish their task quickly. And we regard those who are unceasingly rendering this service at home and who are best qualified for it, as equal in devotion to duty with those who wear the overseas cap.

The members of the American Foundrymen's association and the other organizations co-operating with it in the 1918 convention have before them a task of huge proportions in doing their full duty at this time. Anyone who knows them as I do, knows they will fulfill every obligation, and need no urging. You realize that every moment of time or ounce of energy wasted in the United States increases the casualty lists of our army. The allies are steadily pushing toward Berlin those who would have made it the capital of a conquered world. This progress can only be speeded up by the most vigorous co-operation at home with that of those whose job it is to shoot and cut their way through the resisting lines of the enemy. No sacrifice that we can make is comparable in the slightest degree with that being made every hour in France by our men whose blood is bathing her soil. Those who are going through Hell for you and me are confidently looking toward America for that supreme manifestation of speed and efficiency of which her people are capable. Their belief that they are being backed up to the limit at home is as steadfast as is their faith in God. Being near to but not of these heroes, without credentials from them but voluntarily speaking for them as an individual, I salute you as brother-patriots, whose sole purpose now is the preservation of liberty for our own and future generations.

(Signed) R. A. BULL.

(Self-censored, R. A. Bull, Capt. Ord., Dept. A. E. F.) France, Aug. 29, 1918. (Mailed Sept. 3, 1918.)



ATTRACTIVENESS WAS IN NO WAY SACRIFICED IN THE ARRANGEMENT OF THE DISPLAYS ON THE MAIN ARENA FLOOR OF MILWAUKEE'S VAST AUDITORIUM

Exhibition Reveals War Capacity of Foundries

Great Show at Milwaukee Discloses Ability of Equipment Manufacturers to Master War Problem of Promoting Production With Fewer Workmen

FOUNDRYMEN learned at Milwaukee during convention week that the government, in grouping America's united resources for quick and successful carrying on of the war, will rely to a greater degree than before upon the castings industry. Government officials who attended the convention learned also that American foundrymen are alert to the possibilities offered by a broader translation of foundry activities to the field of war work. Technical sessions devoted to ordnance making problems drew the record attendance of the week and brought out the most active discussions.

Linking the two, the prospective producer and purchaser, was the thirteenth annual foundry and machine exhibition. Here for the first time, many foundrymen saw not only the instruments which are available, for the rapid production of war materials, but also many who are just commencing to produce parts for the ordnance department obtained their first view of the finished assembly, such as the trench-mortar bomb, grenades, or cannon. At the same time, government officials who came to Milwaukee to stimulate interest in munitions production saw the great adaptability foundry equipment manufacturers have shown in developing means for meeting the widely divergent problems facing the foundrymen. Any question of the capacity of the foundry industry for meeting the suddenly expanding war program was effectually answered by an inspection of the displays filling the two floors of the large Milwaukee auditorium.

Developed as an educational force for affording visiting foundrymen the opportunity of inspecting annually the progress made during the preceding year along mechanical lines, the 1918 exhibition fulfilled its mission to a higher degree than any of its 12 predecessors. Throughout the 45,000 square feet devoted to the 200 separate displays, ran the dominant theme of war production, rapid and efficient. The foundryman who desired to vitalize his plant into an effective component of the great war machine which the United States has become, found spread before him on all sides the instrumentalities for this transformation.

War Exhibits Win Favor

The commercial element, ordinarily predominant at industrial exhibitions of this character, was subordinated at the Milwaukee exposition, to the patriotic. The exhibits based their appeals largely upon their facilities for war work and it was on this basis that they won approbation. Their wartime character ranged from the government's display of ordnance equipment, to labor-saving equipment and means for advancing production.

Methods of molding and casting semisteel shell. Newton-Stokes trench-mortar bombs, rifle and hand grenades, truck parts, etc., were revealed in booths on the lower floor where machines and apparatus were shown in operation. Evidence of the completeness of the exhibit was afforded by the 32 live exhibits on the same floor, where machine tools and machine-shop appliances were employed in machining these military products.

All exhibits were displayed under unusually favorable conditions, as the huge auditorium was admirably adapted for such purposes. The two floors were artistically decorated and ample light was provided. Decorations in the national colors added to the appeal of the exhibition. Operating equipment was grouped on the basement floor or machinery hall, the other exhibits occupying the ground floor or arena.

Labor saving as a natural complement of war production received the closest attention, and the visitors found in the exhibits many appliances designed particularly for the conservation of manpower. Methods of maintaining and even increasing production with fewer workmen were disclosed by many exhibits, including those devoted to cranes, trolleys, hoists and other apparatus for handling and conveying materials, cleaning-room equipment, molding machines, sand-blast equipment, grinding machines and cutting and welding apparatus. Automatic and semiautomatic machines figured largely in the exhibits.

Ordnance Display Was Complete

In the preparation of the exhibit of the ordnance department, manufacturers in the Milwaukee district were called upon largely and the completeness of the display thus testified eloquently to the vast scope of the entire country's manufacturing industries. The display was in charge of Lieut. A. B. Wallace. Included in the exhibit were tubes of the famous 75-millimeter field gun, in various stages of forging, together with finished tubes and slide mechanisms for both the American and French types. The slide on the French gun in a bronze casting. Steel shell of a variety of sizes were shown as well as cast semisteel shell. Newton-Stokes trench mortar bombs, airplane bombs, hand grenades, gas shell, gas grenades, smoke grenades, phosphorus grenades, gun limbers, truck wheels, tractor castings, etc., also were on display.

To the manufacturer seeking relief from the constantly tightening labor situation, the 1918 exhibition of foundry and shop equipment was a veritable revelation. In fact it is not too much to say that the conservation of manpower, for the purpose of releasing more men for the army without cutting down the production of essential and vitally needed war materials, was the keynote of the exhibition. In the displays of cleaning-room equipment, cranes, trolleys, hoists and other apparatus for handling materials, as well as in the exhibits of molding machines, sand-blast equipment, grinding machines and welding apparatus, were found specially pertinent suggestions bearing on the problem of obtaining more output with less men. Machines of the automatic or semiautomatic type were far more numerous than at previous shows.

Two vast floors of the great Milwaukee auditorium were crowded with exhibits. As the accompanying illustrations indicate, the show was arranged in an unusually convenient and attractive manner. An abundance of light and a vaulted ceiling tastefully set off with red, white and blue streamers contributed materially to an attractive general effect.

Army Ordnance Display

Prominent among the 200 displays was the exhibit of the army ordnance department which was under the supervision of Lieutenant Wallace. Its conception was purely educational and it amply fulfilled its purpose. In fact this display alone was worth a long trip to Milwaukee, especially to manufacturers coping every day with war production problems. The government's exhibit, in addition, formed an index of the vast capacity of the nation's war industries, which are now operating throughout the length and breadth of the country triple shifts to beat the Hun, for practically all of the numerous items in the display were produced within the Milwaukee district. The war exhibit under the direction of Lieutenant Wallace included barrels of the famous 75-millimeter field gun which is being produced in quantity in Wisconsin. The steps in manufacture together with the points in operation which distinguish this arm were the source of particular interest to all visitors. Steel shell of all kinds and sizes were exhibited, some of them being shown in section. Cast semisteel shell also were shown, together with Newton-Stokes trench-mortar bombs, airplane bombs, hand grenades, gas shell, gas grenades, smoke grenades, phosphorus grenades, gun limbers, truck wheels, tractor castings, etc., etc.

There were 21 exhibits by molding machine manufacturers, including over 80 machines of various types and sizes. As is customary, many of the machines were shown in actual operation. Interest centered on methods of rigging-up the machines for war work, rather than on the details of the machines themselves, as at previous exhibitions. In fact molding machines have now become quite thoroughly standardized, and there are therefore fewer radical innovations from year to year. Within the past 12 months, also, the manufacturers have been so busy with production problems that experimental work on new machines has been relegated to the background, unless for some specific war purpose, such as the new Pridmore 8000-pound combined pneumatic and electric roll-over jar-

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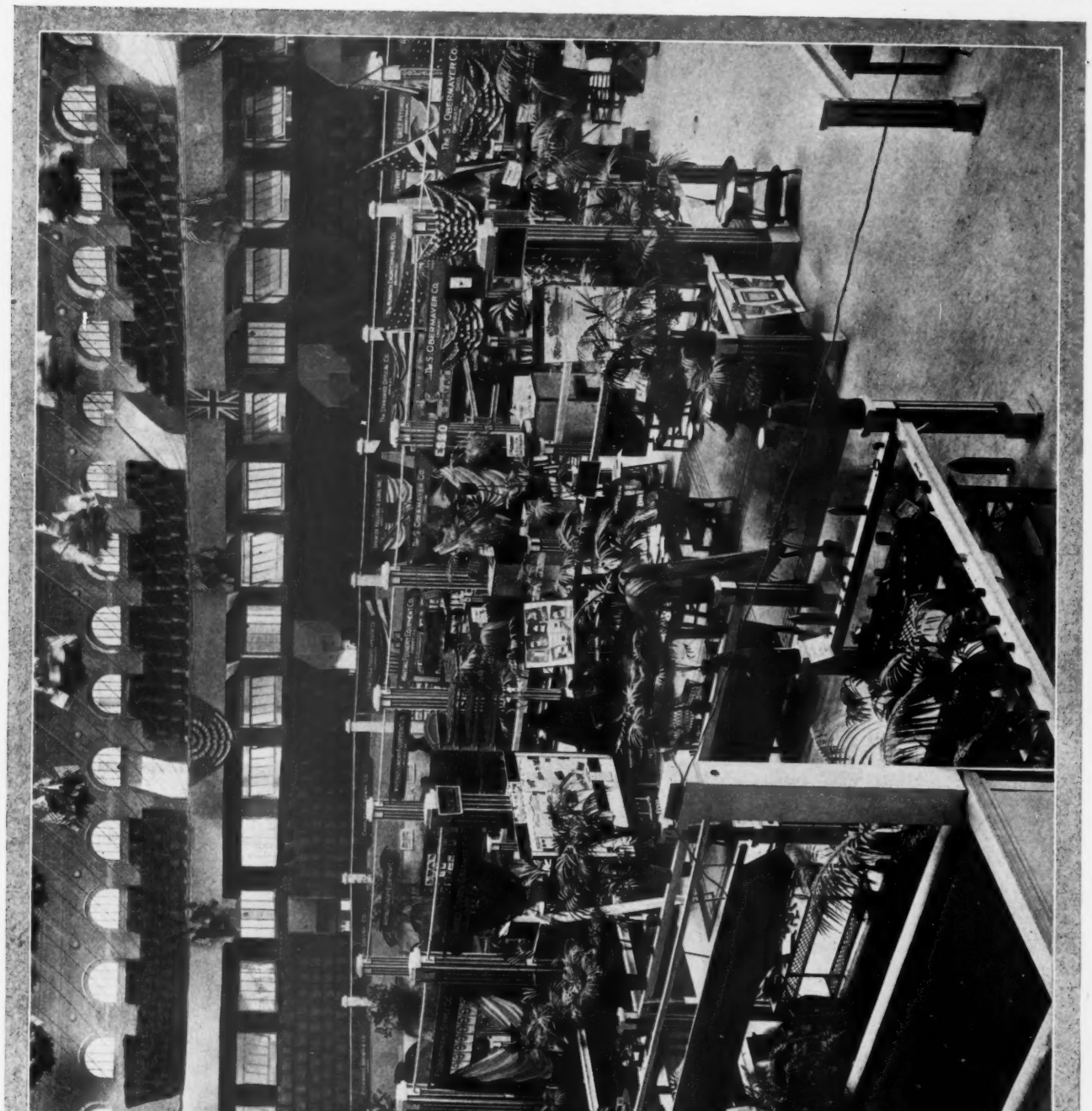


WAR'S INFLUENCE AND THE SINGLENESS OF PURPOSE WHICH MADE THIS EXHIBITION OF VALUE TO THE MANUFACTURER OF WAR ESSENTIALS EVERYWHERE WERE EVIDENT

ramming machine developed for speeding-up the production of military-truck wheels.

A number of molding-machine manufacturers displayed special riggings which they have developed for adapting their machines to shell and grenade production and similar problems. Prominent among these was the Cleveland-Osborn Mfg. Co., Cleveland. This company, under the direction of H. R. Atwater, has designed an exceedingly interesting special rigging for molding Newton-Stokes trench-mortar bombs on a combination jolt stripping-plate machine of 1500 pounds capacity.

The job is arranged to go in a two-part cast iron flask of rigid construction. In addition, a dry-sand cover core is employed as a cope, the two parts of the flask forming the drag and cheek respectively. The shell is cast nose down, with the wind vanes firmly bedded in the sand in the drag. Both the drag and the cheek are molded at one time on the machine, which has a production of 175 molds a day. There are two castings in each mold; therefore each machine unit delivers 350 trench-mortar shell a day. The metal enters the mold through knife gates attached to the shell forward of the bourrelet. The knife gates lead in turn to vertical finger gates which carry the metal from the cover core through the cheek to the drag. Either a green-sand or dry-sand core may be employed. It is molded on a small plain jar-ramming machine, using a split core box of metal construction. The core is rammed around a pipe arbor of standard pattern.

Molding Machines Show War Slant

Operating machines and equipment, which formed the main bulk of the exhibits in the machinery hall beneath the arena of the auditorium, all demonstrated in a measure the effect of the pressure of war on manufacturing. Molding machines for special shell work, bombs, and grenades mirrored one phase of the war's influence on the foundry equipment business, while the introduction of simple control features, and features which make heavy foundry equipment suitable for operation by women employes was another interesting development directly traceable to war's industrial demands.

The exhibit of Henry E. Pridmore, Chicago, again indicated the influence of foundry shell production on molding-machine design. An entirely new stripping plate machine with electric jar mechanism and air stripping feature has been developed by this company for use in making shell molds. This machine is a refinement of design based on the performance of standard machines which are in service in some of the first foundries which produced cast shell in this country. One of these machines was shown in operation. The other molding machines displayed included a 24-inch combination electric jar-ramming and air power rock-over hand-drawn machine with a 9-inch drop; a 24 x 24-inch, 8-inch draw combination electric jar-ramming and air power stripping-plate machine; a 16-inch, 9-inch drop combination electric jar-ramming and hand rock-over drop machine; a 29 x 24-inch, 8-inch drop power rock-over drop machine; a 12 x 12-inch square stand machine and a heavy double shaft stripping-plate machine.

The Davenport Machine & Foundry Co., Davenport, Ia., displayed one of the largest molding machines shown at Milwaukee. This machine, capable of handling a flask up to 8000 pounds in weight, was coupled to the air line, and its operation was demonstrated. The jolt ramming and rock-over operations in this machine are controlled by air cylinders, while the pattern-drawing table is raised and lowered by a piston operating in an oil filled cylinder. An ingenious arrangement of four supports, one at each of the corners of the pattern-drawing table, which are wedged into position against the bottom board when the flask is rolled over, permits the bottom board to rest squarely on the table when raised, independent of surface irregularities. These four supports, or short columns are brought to bear against the bottom board with equal pressure by means of a single lever. A core jolt machine and two types of squeezers also were shown by this company.

The U. S. Molding Machine Co., Cleveland, has developed a jolt-squeeze machine adaptable to shell work, and included it as a feature of its extensive molding-machine exhibit. Other machines which were in operation in the space alloted to this company included a plain air-jolt machine, a jolt and squeeze machine, a jolt, squeeze and pattern-drawing machine and a plain air squeezer. These machines were shown in operation.

A machine which has been for two years in daily operation at the foundry of the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., was borrowed by its manufacturers, the Tabor Mfg. Co., Philadelphia, and shown in operation on the floor of the machinery hall. This machine, which is of the combination shockless jar-ramming roll-over and pattern-drawing type, was used for the production of radiator tops and parts for automobiles.

The Arcade Mfg. Co., Freeport, Ill., displayed its latest type combination jolt, squeeze and pattern-drawing machine equipped with a plate for special work and a wide range of the castings produced from molds made on this machine. These castings included complex plumbing parts in brass and a number of small gray-iron castings such as gas-engine pistons. Other machines shown by this company were air squeezers, combination jolt and squeeze and plain jolt machines. A hand-operated pouring device was also exhibited.

Saving manpower found its ultimate interpretation in the exhibit of E. J. Woodison Co., Detroit. A skilled woman operator was employed during the exhibition making cores on a special automatic coremaking machine built by this company. It is stated that women working with this machine in one of the largest automobile plants in Detroit, today are doubling the production of cylinder cores attained by men coremakers previous to the war. Other machines shown by this company included electrically-driven, jar-ramming, roll-over pattern-drawing machines, air squeezers and universal sensitive core machines for making duplicate cores. An exemplification of the company's trade name was carried in a model of its plant, complete to the smallest detail and made from cores in which this company's core binder was used. A line of foundry, plating and polishing supplies also was shown.

The head-room clearance of the machinery hall, where the operating machines were placed was taxed by some of the larger roll-over machines which have been developed recently. Machines which customarily may be built with a pit foundation, by reason of the concrete floor of the exhibition hall, were placed all above floor level. The Dayton Molding Machine Co. was able to set up and place in operation a 28-inch jolt rock-over pattern-drawing machine, with a 12-inch draw. The other machines shown by this company were a 12-inch jolt squeezer, and a 16 x 16-inch jolt-squeeze pattern-drawing machine. These also were in operation.

The Grimes Molding Machine Co., Detroit, demonstrated the operation of a jar-ramming roll-over molding machine, a hand ramming roll-over molding machine and a small core-making machine. These machines have all been developed with a view to operation by women. Additional rigidity and improved valve action are points of improvement over older designs.

The Federal Foundry Supply Co., Cleveland, had an extensive display of small molding machines, pattern-drawing machines, vibrators, both electric and air, snap flasks, chaplets and flask trimmings. Plumbago and steel cement for repairing small blow holes also were shown.

Other exhibitors of core and molding machines in many cases combined a wide range of miscellaneous equipment used in the foundry. The Brown Specialty Machinery Co., of Chicago, presented three types of machines for making cores from ⅜ to 7 inches in diameter. This company also exhibited an 84-inch table rotary sand-blast machine, which was geared to a motor and revolved to demonstrate its operation, and a pneumatic charging truck for malleable iron annealing pots.

Among other exhibitors of molding machines whose products were shown either by machines in actual operation or by photographs were: Champion Foundry Machine Co., Chicago; Berkshire Mfg. Co., Cleveland; Herman Pneumatic Machine Co., Pittsburgh; Mumford Molding Machine Co., Chicago; American Molding Machine Co., Terre Haute, Ind.; Wm. H. Nicholls Co., Inc., Brooklyn, N. Y.; International Molding Machine Co., Chicago; Foundry Appliance Co., Newark, N. J.; Foundrymen's Supply Co., Milwaukee; and Freeman Mfg. Co., Racine, Wis.

Sand-Blasting Ascendant

Probably no single angle of foundry practice has received more intimate study during the past year than cleaning-room operation. Economy of time and labor, forced by the shortage of both of these factors, previously expended without stint, have served to develop sand-blasting most rapidly. The small foundry no longer can afford to disregard the questions of time and cost with reference to castings after they come from the mold, and the wide range of sand

CLEVER AND ARTISTIC ARRANGEMENT SERVED TO SET OFF MANY OF THE EXHIBITS OF MATERIAL WHICH BY NATURE WOULD NOT BE CONSIDERED ATTRACTIVE

INFORMATION FOR THE BRASS FOUNDRYMAN

Heat Resisting Castings

Aluminum Bronze

	Per Cent
Copper	90.00
Iron	0.50
Aluminum	9.00
30 per cent Manganese copper	0.50

Melt the copper under charcoal, add the iron in the form of loosely coiled tin plate clippings, or thin, clean wire. Stir vigorously, add 2 per cent of the aluminum, again stir to incorporate all the iron, add the manganese copper and lastly the remainder of the aluminum. Gate the castings from the bottom. Use heavy risers to feed metal to supply the shrinkage, and pour the molds before the metal appears dull in color. The castings, if small in section will possess approximately the following physical properties:

Tensile strength, lbs. per sq. inch	80,000
Yield point, lbs. per sq. inch	26,000
Elongation, per cent in 2 inches	30.00
Reduction of area, per cent	28.00

Aluminum bronze is tough and ductile up to a red heat and can be forged.

Heat Resisting Bronze

	Per Cent
Copper	91.00
Tin	4.50
5 per cent phosphor-tin	4.00
Lead	0.50

Melt the copper under charcoal, add 1 per cent of the phosphor-tin, then the ordinary tin, next the balance of the phosphor-tin, and lastly the lead. Stir thoroughly. Use large risers to feed the castings solid all through, and pour the metal at a temperature at which it appears bright. This alloy is phosphor-bronze.

Brass containing more than 10 per cent of zinc is not suitable for heat resisting castings.

INFORMATION FOR THE BRASS FOUNDRYMAN

The Effect of Various Elements on the Strength of Manganese Bronze

An investigation has been recently carried out by E. Millington to ascertain the influence of the usual additions of tin, manganese aluminum and iron on brass of the following composition: Copper, 60 per cent, and zinc, 40 per cent, the proportions usually present in manganese-bronze. The results are tabulated as follows:

Composition of Original Alloy

Copper 60; Zinc 40.

Impurity Per Cent	Effect on Yield Point Per Cent Increased	Effect on Maximum Stress Per Cent Increased	Effect on Elongation Per Cent Decreased
Tin			
1.1	19.0	11.0	61.0
2.13	33.0	4.0	83.0
Manganese			
1.16	11.9	12.3	25.5
2.07	11.9	12.3	improved
Aluminum			
1.06	increased	increased	73.0
1.9	89.0		89.0
Iron			
1.2	9.5	12.7	37.0

In making the alloys, the copper content of the 60-40 alloy was reduced by the amount of the tin, manganese, aluminum or iron that was added. All these elements increase the yield point and tensile strength, but reduce the elongation of the pure brass.

The Effect of Cadmium on Copper-Zinc Alloys

Researches recently conducted by Leon Guillet to determine the effect of using zinc containing cadmium for making brass gave the following results:

Up to 1 per cent of cadmium, no injurious effect can be noticed.

With more than 1 per cent of cadmium, the resilience of the brass is markedly lowered, but up to and under 2 per cent cadmium, the tensile strength is not injured.

THE FOUNDRY DATA SHEET, NOVEMBER, 1918
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication
Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

blast equipment shown at the Milwaukee machinery show included much that was adaptable to the ordinary foundry.

One entire corner of the machinery hall was occupied by a single exhibit prepared by the Pangborn Corp., Hagerstown, Md. One operating installation shown was a table-cabinet type sand-blast with standard direct pressure hose machine with a screw conveyor beneath the platform from the cabinet to the sand separator and a bucket elevator. This equipment is capable of handling a wide range of miscellaneous work. Another type shown was a self-contained, sight-feed, stationary nozzle suction cabinet. A third installation demonstrated a suction cabinet sand-blast which was self contained, with a supported moveable nozzle adjustable in every direction.

Probably the most interesting feature of this exhibit, however, was the compact, self-contained, sight-feed cabinet sand-blast for finishing the inside of any size of shell. This machine consists of four rotating chucks, driven at slow speed by means of a belt, and suitably shaped for holding the shell. In operation the shell are placed vertically, with the nose held in the rotating chuck. Four suction-type blast nozzles are placed to project at a slight angle inside the shell opening, so that the blast strikes all points within the shell when the later is rotated. The blast may be cut off from any of the four nozzles, independently of the others. The operation is stated to be practically continuous, as the shell are placed in position successively, and when the last is set in its chuck, the first shell is ready for removal.

The W. W. Sly Mfg. Co., Cleveland, had on display in the arena of the auditorium a large horizontal sand-blast mill, together with a number of photographs of installations of sand-blast machinery and other cleaning room devices manufactured by this company. Other exhibitors of cleaning room and sand-blast machinery included: McLeod Co., Cincinnati; New Haven Sand-Blast Co., New Haven, Conn.; W. F. Stodder, Syracuse, N. Y.; Hoevel Mfg. Corp., New York; and American Foundry Equipment Co., New York.

Good Mixers

In line with the single lump of sugar in the breakfast cup of coffee, modern sand and its binding medium require thorough mixing. Mere perfunctory hand stirring will not produce the results sought. To demonstrate the means by which the thorough coating of every grain of sand is approached in its mixer, the Blystone Mfg. Co., Cambridge Springs, Pa., had in operation a 7-cubic foot motor driven core sand mixer.

The Sand-Mixing Machine Co., New York, occupied exhibit space jointly with the American Foundry Equipment Co., New York. The former company demonstrated the operation of its improved auto sand cutting machine, while the latter showed a rotary-table sand-blast cabinet.

The National Engineering Co., Chicago, had a Simpson foundry mixer in operation on the floor, using sand and binder as in regular practice. This mixer was equipped for electric drive, but is readily adaptable to belt, shaft or gear drive. Photographs of a bucket loader, a continuous core reducer, a screen separator and other foundry equipment, also were shown.

The Standard Sand & Machine Co., Cleveland, demonstrated in operation a core and facing sand mixer, which was direct motor driven.

Varied types of riddles were exhibited in operation. The Great Western Mfg. Co., Leavenworth, Kans., showed two types of gyratory foundry riddles. The Schroter Engineering Co., Chicago, had in operation a gyratory riddle arranged for the use of electrical power through a lamp socket connection. The Battle Creek Sand Sifter Co., Battle Creek, Mich., displayed air-driven, hand and belt driven sand sifters, together with sprayers for blacking cores and molds.

A complete working exhibit of models of clamshell and orangepeel buckets, with an electric motor bucket in operation were shown by the Hayward Co., New York. This company also had a wide range of photographs of typical installations.

The Whiting Foundry Equipment Co., Harvey, Ill., showed a diversity of standard foundry essentials. Different types of core ovens, tumbling barrels, worm geared ladles, small air hoists, foundry trucks, turntables and a large collection of photographs comprised this exhibit.

Wartime Conservation Aids

Several types of separators for foundry use formed an important though limited division of the Milwaukee machinery show. The Magnetic Mfg. Co., Milwaukee, showed a magnetic separator for use in either iron, steel or malleable foundries. This separator is provided with an elevator by means of which material is conveyed up and dumped into a hopper. The iron is extracted and any coke, slag or hard lumps are discharged into a separate receptacle. Other equipment shown included two pulley type separators suitable for use in iron, steel or brass foundries. Two brass separators completed the exhibit.

Dings Magnetic Separator Co., Milwaukee, had a number of types of equipment in operation. These included a machine with a motor-generator set, another with a large diameter magnetic pulley, and yet another which is adapted particularly for use in smelting and refining works. The separator equipped with a motor is used in gray iron, steel and malleable foundries for removing iron ordinarily wasted on the dump.

The Deister Concentrator Co., Ft. Wayne, Ind., exhibited a laboratory size diagonal-deck table designed for the treatment of foundry residue.

Air pressure was delivered to all exhibition spaces where it was desired. Pipe lines were run overhead and connections were cut in to provide for the operating lines of molding machines, sand-blasts and pneumatic machinery of every class. The compressor was supplied by the Sullivan Machinery Co., Chicago. This compressor was a compound belt-driven machine with a rated capacity of 445 cubic feet per minute against a pressure of 100 pounds per square inch. It was driven by a 75-horsepower General Electric motor. New features incorporated in the compressor include plate valves which are used in both the high and low pressure cylinders for both inlet and exhaust.

Saving Labor in Handling Operations

Possibilities for labor saving held out by the increased use of handling and conveying apparatus were clearly disclosed by the exhibits devoted to such equipment. The shortage of manpower in foundries naturally has led all foundrymen to make a closer study of the possibilities of performing with mechanical equipment and fewer men, the work formerly done by larger gangs of workmen. Particular interest, consequently, was shown in the handling and conveying equipment exhibits since probably no other field has revealed larger opportunities of labor conservation.

Indicative of this change in modern methods of handling materials in the foundry were the exhibits revealing the extent to which roller bearings are now being applied to foundry equipment. The Hyatt Roller Bearing Co., New York, had a complete display which included roller-bearing I-beam trolleys; countershaft bearings, two small test cars, one equipped with roller bearings and one with plain bearings, mounted on a T-rail to demonstrate the easy running qualities of cars equipped with roller bearings; an industrial truck wheel showing how roller bearings are applied to a truck; roller bearings mounted in glass tubing and revolved by an electric motor to demonstrate the oil-distributing function of this bearing; and a small model of a steel mill roller table equipped with roller bearings in self-aligning housings.

The Norma Co. of America, New York, exhibited various types of ball and roller bearings, illustrations being shown to indicate the application of these bearings to different kinds of machinery.

The Abell-Howe Co., Chicago, revealed in its exhibit the extent to which trucks can be employed in foundry operations. Trucks displayed were arranged for hand trucking or for use with power tractors as trailers. Moving pictures and photographs were employed to illustrate the applications of these trucks in a foundry. An electric hoist also was displayed.

Overhead carrying truck equipment for conveying loads in foundries were displayed by the Richards-Wilcox Mfg. Co., Aurora, Ill. A part of the exhibit was devoted to an I-beam carrying system designed for handling loads from one part of the foundry to another, or from the molding floor to the cleaning room, stockroom or shipping platform. Chain hoists for facilitating the placing of castings on machine tools, or in stock bins also were shown.

The Louden Machinery Co., Fairfield, Iowa, exhibited its overhead carrying system. One element of this system provides for the transfer in metal containers, traveling on a monorail system, of scrap from the molding room, or the machine shop, to a central storage yard. These carriers

also are used for handling sand. They can be lowered to the floor to permit easy loading. Through a hoisting gear, a 1-pound pull on the hand chain gives a 40-pound lift on the hoisting chains. One man can thus handle heavy loads easily.

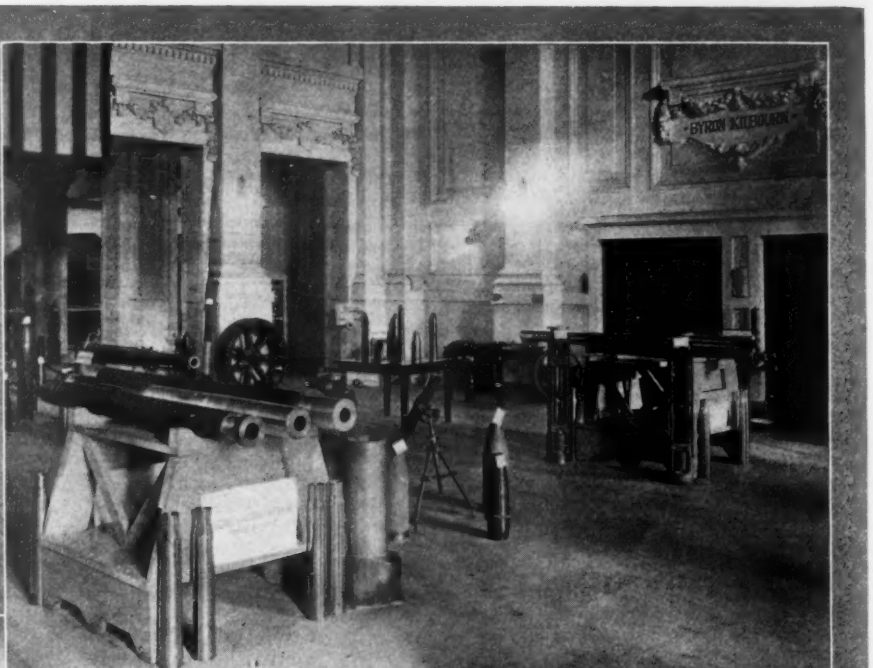
The Pawling & Harnischfeger Co., Milwaukee, exhibited a ½-yard single line grab bucket, photographs being used to illustrate various types of cranes, hoists, grab buckets, drilling and boring machines and excavators. The Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., exhibited photographs of its electric cranes and hoists for foundry use.

Cores for a wide variety of intricate work were displayed by a number of companies. In many cases these cores were for use in the production of ordnance equipment, army trucks and motors. These displays indicated clearly the national trend for more efficient methods of manufacture, and for conservation through increased durability of the machines employed in turning out finished products.

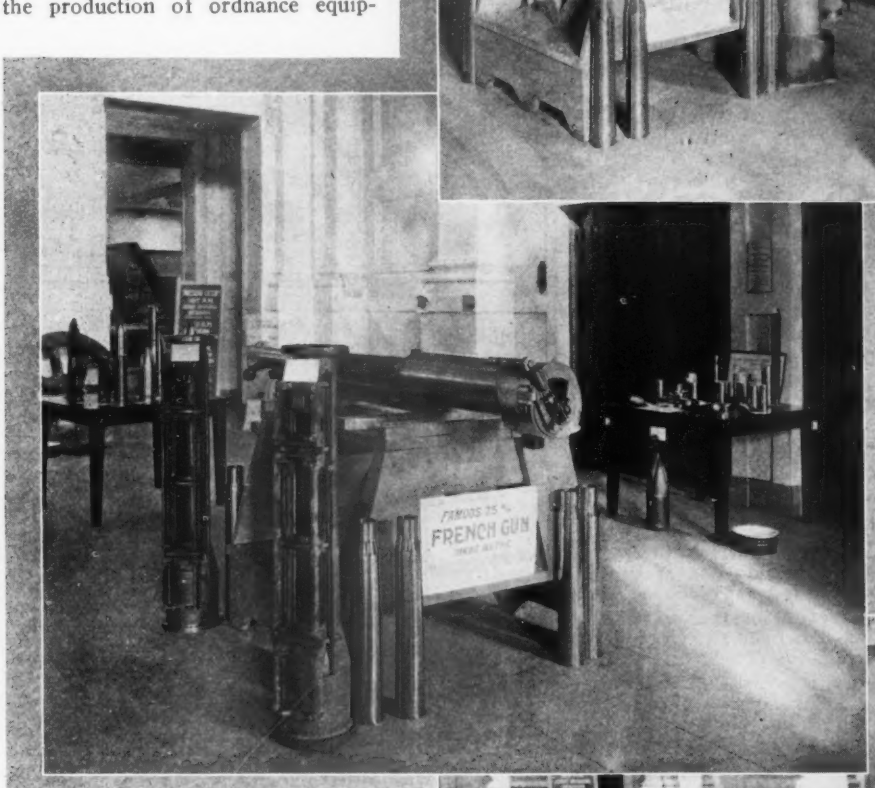
The American Gum Products Co., New York, had an interesting display showing cores made with the binder manufactured by this company. These cores included one for a 4-cylinder motor made with a 110 to 1 mixture, one for a large valve and one for the compression head for an ice machine.

The United Compound Co., Buffalo, displayed samples of its line of vent and pattern wax. Displays also were made of cores vented with this wax.

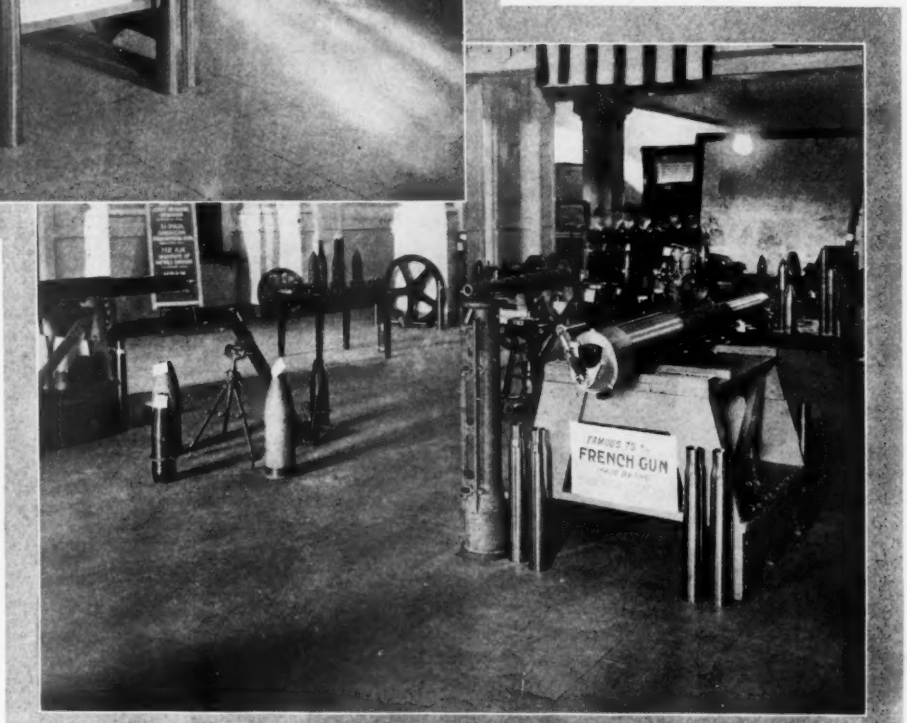
Practically all exhibitors of core compounds displayed cores or castings in the manufacture of which their products were employed. These exhibitors included Swan &



THE ARMY ORDNANCE DISPLAY IN THE MAIN ENTRANCE CORRIDOR EMPHASIZED THE WAR CHARACTER OF THE ENTIRE EXHIBIT



BRONZE CASTINGS WHICH FORM THE SLIDES FOR THE FAMOUS FRENCH SEVENTY-FIVES PROVED A CENTER OF ATTRACTION FOR VISITING FOUNDRYMEN



GUNS, SHELL, BOMBS, MORTARS, GRENADES AND MISCELLANEOUS ORDNANCE CASTINGS WERE SHOWN IN SUCH A MANNER THAT EVEN A CASUAL INSPECTION SERVED AS A LIBERAL EDUCATION IN THE MANUFACTURE OF WAR MATERIALS

Finch Co., New York; Werner G. Smith Co., Cleveland; Robeson Process Co., New York; Mifflin Chemical Corp., Philadelphia; Marden, Orth & Hastings, Corp., New York; Kellogg, Spencer & Sons Inc., Buffalo; Corn Products Refining Co., New York, which produced and baked the cores as a part of its exhibit; and the Holland Core Oil Co., Chicago, which displayed an assembled core for an army truck.

The S. Obermayer Co., Chicago, exhibited core ovens of both the portable and stationary type. In addition, this exhibit included sprue cutters, rosin mills, one being of the outside feed type, tumbling barrels and miscellaneous equipment and supplies.

Core ovens of both the car and drawer types were displayed by a number of companies. The G. S. Blodgett Co., Burlington, Vt., exhibited two types of portable ovens. The Young Bros. Co., Detroit, showed the front half of an 8 x 12 foot oven, with electric heaters, automatic temperature control, control panel and recording thermometer. An arrangement for firing ovens by oil or coke furnaces below the floor level was shown.

The Wadsworth Core Machine & Equipment Co., Akron, O., had an interesting display of coremaking machine and coreroom equipment. This included a motor-driven, self-contained coremaking machine, a core cutting-off coning machine as well as steel reinforcing core and bottom plates.

Welding and Cutting Apparatus

Evidence of the rapid progress made during the past 12 months in the development and application of welding and cutting apparatus was furnished by the exhibits devoted to this line of equipment. These exhibits included not only apparatus for use in foundry cleaning rooms but for general repair work. In most cases, actual demonstrations of the process of welding or cutting were given.

The Davis-Bournonville Co., Jersey City, N. J., displayed an unusually interesting series of apparatus for cutting and welding work. Included among these was a machine for cutting steel plate from 1 to 15 inches or more in thickness, according to drawing or pattern. The machine follows the pantagraph principle. A motor-propelled tracing wheel is employed which follows the lines of the drawing, which in turn are reproduced with the cutting torch. Either the oxyacetylene or oxyhydrogen cutting flame is employed. The small motor driving the tracing wheel is the only power required. Other machines were for handling both light and heavy cutting of steel up to 18 inches in thickness and for cutting circles. Welding units also were exhibited.

An oxweld generator was displayed by the Oxweld Acetylene Co., Chicago. This unit has an hourly capacity of 50 cubic feet and the gas was used in cutting and welding various iron and steel articles. Welding and cutting torches, tips, etc., also were shown. In addition, a working exhibit was presented of the apparatus manufactured by the Prest-O-Lite Co., Indianapolis.

The Metal & Thermit Corp., New York, included in its exhibit a large weld made on a crankshaft by the thermit process. Pictorial displays were made of welding work of an unusual nature. Samples of all of the carbon-free metals and alloys made by this company were shown.

An oxyacetylene torch which is adapted for both cutting and welding, combining the two operations in a single unit, was displayed by the Alexander Milburn Co., Baltimore. A high pressure acetylene generator also was operated, this machine carrying a 10 per cent overload and being designed to eliminate undue heating on standard charges of carbide. Portable carbide lights formed a part of the display.

The Air Reduction Sales Co., New York, exhibited oxyacetylene cutting apparatus and generators. Practical demonstrations were given. Other exhibitors of equipment for cutting and welding included the Bastian-Blessing Co., Chicago; the Arcwell Corp., New York, and the Torchweld Equipment Co., Chicago.

Furnaces of many different types and designed for a wide variety of uses were on display. The Hausfeld Co., Harrison, O., exhibited an open flame, noncrucible furnace, a crucible tilting furnace and a tilting aluminum furnace with a 100-pound iron pot. The Ludlum Electric Furnace Corp., Chicago, and the Pittsburgh Furnace Co., Milwaukee, exhibited their types of electric furnaces by model and photographs. The Monarch Engineering & Mfg. Co., Baltimore; the Buckeye Products Co., Cincinnati; and the Mahr Mfg. Co., Minneapolis, exhibited melting furnaces. The Buckeye company also displayed burners, vibrators, parting compounds, core compounds, and other types of foundry supplies. The Mahr company displayed oil burning torches, ladle heaters, burners, forges, and driers. Apparatus for use with melting equipment was exhibited by the Maxon-Premix Burner Co., Muncie, Ind.; Hauck Mfg. Co., Brooklyn, N. Y.; and Charles J. Clark, Chicago. The Quigley Furnace Specialties Co., New York, demonstrated a highly refractory furnace cement by means of a small, high temperature electric furnace.

Rogers, Brown & Co., Cincinnati, displayed different types of castings, all of which enter into government work. One was the radiator for a truck, and others were for ordnance and ship work.

Pickands, Brown & Co., Chicago, had an unusual display. An officers' tent at headquarters was constructed entirely from by-product coke. Foundry coke was used for the front, back and sides and crushed sizes for the roof.

Semisteel castings of light section, such as automobile cylinders, containing from 20 to 50 per cent steel, were displayed by McLain's System Inc., Milwaukee. These castings were made by graduates of this school. The McLain-Carter Furnace Co., Milwaukee, exhibited open-hearth castings poured from metals made in this type of oil-fired furnace.

The Locke Pattern Works, Detroit, displayed a complete set of metal pattern equipment for making a 155-millimeter howitzer shell. Mahogany patterns for government trucks and cast and aluminum plates for small parts of government tractors were also shown.

MACHINERY HALL BENEATH THE ARENA FLOOR OFFERED EXCEPTIONAL FACILITIES FOR THE DISPLAY OF FOUNDRY SUPPLIES AS WELL AS MACHINERY AND EQUIPMENT

The Allis-Chalmers Mfg. Co., Milwaukee, displayed a wide line of power plant equipment. This included an 18,000 foot-pound, automatic coil pressure governor for controlling the speed of hydraulic turbines. This unit is designed for remote control so that two or more can quickly be placed in synchronism. Other equipment displayed included a 50 cubic foot air compressor, a 6-inch centrifugal pump and models of large turbine runners.

Nonferrous alloys and metals used in foundries were attractively displayed by a number of manufacturers. In ingot form were displays of brass and bronze, as well as samples of copper, aluminum, tin, lead, spelter, antimony, and other metals and alloys. Castings also were shown. These manufacturers included the Loewenthal Co., Chicago; S. Birkenstein

Sons, Chicago; New Era Mfg. Co., Kalamazoo, Mich.; and Progressive Metal & Refining Co., Milwaukee.

Safety equipment of various kinds were prominent in the exhibits. These included goggles, helmets, masks, leggings, signs, and wearing apparel. A nonshattering glass was demonstrated. These exhibitors included the Strong, Kennard & Nutt Co., Cleveland; Julius King Optical Co., Chicago; Standard Optical Co., Geneva, N. Y.; Holcomb Safety Garment Co., Chicago; R. P. Smith & Sons, Chicago; and F. H. Wheeler Mfg. Co., Chicago.

Other exhibitors whose displays drew attention were the Portage Silica Co., Youngstown, O.; Gordon Sand Co., Conneaut, O.; United States Silica Co., Chicago; Sheriffs Mfg. Co., Milwaukee; Republic Creosoting Co., Chicago; Peck Iron & Steel Works, Kalamazoo, Mich.; David Lupton's Sons Co., Philadelphia; T. P. Kelly & Co., New York; Laclede-Christy Clay Wheelbarrow Co., Milwaukee; Leeds & Northrup Co., Philadelphia; Western Electric Co., New York; American Kron Scale Co., New York; Walter H. Wangelin & Co., St. Louis; Monroe Calculating Machine Co., Chicago; Rothacker Film Mfg. Co., Chicago; Barrett Co., Chicago.

Wood and Metal Working Tools

A certain number of power tools, usually placed in the pattern shop, always have been part of the equipment of a well organized foundry. But today, that foundry which is preparing to engage in the production of cast shell receives a higher rating in the eyes of the ordnance department if metal working machine tools are at hand and available. The machine tools displayed at the Milwaukee convention indicated a strong tendency in the direction of machine shops as an adjunct to the complete foundry. Sanders, wood millers, wood

BRASS FOUNDRY EQUIPMENT AND SUPPLIES MADE UP A LARGE AND IMPORTANT GROUP OF EXHIBITS

Products Co., St. Louis; Charles C. Kawin Co., Chicago; Jennison-Wright Co., Toledo, O.; Charles Jurack Pattern Works, Milwaukee; Industrial Electric Furnace Co., Chicago; Illinois Clay Products Co., Oglesby, Ill.; Haynes Stellite Co., Kokomo, Ind.; General Steel Co., Milwaukee; Garden City Sand Co., Chicago; H. M. Lane Co., Detroit; Foundry Equipment Co., Cleveland; Foreign Crucible Corp., New York; Erwin Mfg. Co., Milwaukee; Thomas E. Coale Lumber Co., Philadelphia; Combined Supply & Equipment Co., Buffalo; Clipper Belt Lacer Co., Grand Rapids, Mich.; Thomas Elevator Co., Chicago; Asbury Graphite Mills, Asbury, N. J.; New Chicago Crucible Co., Chicago; Joseph Dixon Crucible Co., Jersey City, N. J.; Frederic B. Stevens, Detroit; United States Graphite Co., Saginaw, Mich.; J. S. McCormick Co., Pittsburgh; Abrasive Co., Philadelphia; Carborundum Co., Niagara Falls, N. Y.; Norton Co., Worcester, Mass.; General Electric Co., Schenectady, N. Y.; Arrow Forging & Tool Works, Chicago; Austin Co., Cleveland; Central Electric Co., Chicago; Sterling turning lathes, shapers and band saws divided honors on the exhibit floors with similar machine tools for use in metal working.

Milwaukee is the home of two well known manufacturers of milling machines, and both of these companies had exceptionally attractive displays. One of these firms, the Kempsmith Mfg. Co., had three horizontal milling machines in operation upon standard work. The other, Kearney & Trecker Co., had a vertical and a horizontal machine connected up to motors and operating upon standard work from its own shop.

The Warner & Swasey Co., Cleveland, exhibited in operation a universal motor-driven turret screw machine operating on chuck work and a universal hollow hexagon motor-driven turret lathe operating on bar work.

The Modern Tool Co., Erie, Pa., had on exhibit a self-contained plain grinding machine in operation, and a range of accessories including self-opening and adjustable screw-cutting die heads, adjustable collapsible taps, solid dies, adjustable hollow milling tools, chuck and collet equipment and tapping appurtenances.

The Racine Tool & Machine Co. had in operation several high speed metal cutting machines of a new type.

The Oliver Machinery Co., Grand Rapids, Mich., had an extensive display of patternmaking machinery including a universal wood milling machine, a universal saw bench; a 30-inch disc and spindle sander and an 18-inch x 8-foot tool-room engine-lathe with attachments. Other equipment shown included a patternmaker's bench, hand planers and jointers and an embossing press for lettering patterns.

The Norton Co., Worcester, Mass., displayed a complete line of grinding wheels especially adapted for foundry use, together with others used in machine tool work. In addition refractory materials and rubbing bricks also were exhibted. A 2-inch floor grinder and a 1-inch bench grinder were shown in operation.

The Acme Machine Tool Co., Cincinnati, had in operation a universal flat turret lathe capable of handling work up to 17 inches with a swing over carriage of 17 inches and over bed of 24 inches.

The Cleveland Pneumatic Tool Co., Cleveland, made an elaborate display of air tools, including drills, sand rammers, core breakers, chipping hammers, riveting hammers, emery grinders, air hose couplings, valves and fittings, hose clamps and air hose.

Simonds Mfg. Co., Fitchburg, Mass., displayed a line of metal cutting saws, files and hack-saw blades, and demonstrated some of its saws in operation on a machine built by the Greenfield Tap & Die Corp., Greenfield, Mass.

Among the other prominent exhibitors of machine tools, patternmaking tools, jigs and auxiliaries were: Southwark Machine Co., Portland, Me.; Syracuse Sander Mfg. Co., Syracuse, N. Y.; Phoenix Machinery Co., Eau Claire, Wis.; Peerless Machine Co., Racine, Wis.; Kelly Reamer Co., Cleveland; McCrosky Reamer Co., Meadville, Pa.; Napier Saw Works, Springfield, Mass.; Badger-Packard Machinery Co., Milwaukee; J. D. Wallace & Co., Chicago; E. C. Atkins & Co., Indianapolis; Bristol Machine Tool Co., Bristol, Conn.; Rivett Lathe & Grinder Co., Boston; Oakley Machine Tool Co., Cincinnati; Marshall & Huschart Machinery Co., Chicago; Mail-o-Meter Sales Co., Chicago; R. E. Ellis Engineering Co., Chicago; Cincinnati Pulley Machinery Co., Cincinnati; and Caulkins-Carpenter Co., Chicago.

The regular monthly meeting of the New England Foundrymen's association which was to have been held in Boston on Oct. 9 was postponed on account of health regulations prohibiting public gatherings during the prevalence of influenza. The next meeting is scheduled for Nov. 13 and will be held at the Exchange Club, Boston.

Formal transfer of real estate by the Atlantic Foundry Co., Cleveland, has been made preliminary to its consolidation with the Fulton Foundry & Machine Co. of the same city.

Foundrymen Face New Problems in War Service

Head of American Foundrymen's Association Traces the Many Difficulties Encountered and Progress Made During the Past Year

By Benjamin D Fuller

THE foundry interests of the country have taken their place among the leaders in the work of producing vitally needed material. Steel foundries have been particularly busy with armament, while the gray iron and malleable plants have been called upon to produce trench mortars, shell, hand and rifle grenades, etc. Aluminum and nonferrous foundries have to do with airplane and motor work. In many cases this entailed a transformation in shop equipment and shop practice which has been brought about quickly and cheerfully.

The sudden extraordinary demand for fuel and metal created by the government program and the response of the manufacturing interests has caused a pronounced shortage in iron which in turn has made it imperative that the government assume control and allot to the plants carrying on work essential to this program, their requirements. This has, in many cases, affected the manufacturers of nonessentials until such times as a readjustment may be brought about.

In the train of events and following closely this increase in capacity the iron foundrymen in certain lines have been confronted with a classification of their products as more or less nonessential with the result that many have been compelled to adopt a change of method, venturing into new lines of work, entailing expense in equipment, while others have temporarily closed pending developments; this is particularly true of the stove and hardware manufacturers. It is quite an undertaking to jump from the casting of stoves to the casting of shell, but this has been done by some and we will in all probability see many others follow.

The curtailing of pig iron shipments to those whose business comes within the category of nonessential industries has been a leading factor in the slowing-up of many foundries, with no immediate relief from increased shipments in sight.

Furnaces furnishing iron to foundries have been called upon to hold up deliveries of foundry iron and turn to production of steelmaking pig and while this has caused foundrymen to readjust and has more or less unsettled general business, the wonderful achievements of our government during the past year makes the inconveniences fade into insignificance.

The installation of foundry equipment and modernizing of methods has been tremendously accelerated. Manpower has responded to the call and the production secured by the combination of willing men and modern machinery has been in many cases fairly astounding.

The advance in quality of products also has been notable in many instances. For example, the development of the cast-steel anchor chain, a foundry product showing astonishing results under test. Electric and open-hearth furnaces both show improvement in results. Cupola operation is also coming in for closer study, the introduction of oil for fuel being one of the promising innovations in this connection. Alloys are now successfully produced in cupola practice for mixtures which a few years ago were made entirely by the crucible furnace process.

I would urge the conservation of coke as worthy of our earnest consideration and while it is not wise to save in the furnace to the extent of losing through poor product, there is much useless waste in cupola practice and close attention to quality of material, upkeep of equipment, regulation of blast and conservative charging will show a handsome saving in many cases. By-product coke is being manufactured to a greater extent than ever before. In the purcase of coke I would recommend adding to the specifications a clause defining the minimum size, or, in other words, that the foundry be furnished a screened material. Much inferior coke has been delivered, one of the chief defects being the large proportion of fines or breeze.

Our government in its endeavor to standardize many essential products, has touched the foundry industry in stoves and furnaces. Reducing styles and sizes in this industry, as in others, will effect great economies. A development which has been of peculiar interest is the changing from malleable to cast iron in the manufacture of hand grenades for the government, the change being made with a view to the safety of our troops. The change coming suddenly, was brought about quickly and with but slight disturbance to the industry, furnishing one more instance of the earnestness of the co-operation between the government and the manufacturer.

Of interest and promise to our industry is the adoption by the government of the semisteel shell. Experiments with cast shell seemingly have been sufficiently gratifying to warrant the government in specifying a liberal production and the prophecy that this will take an important place in the industry. Standard methods of producing a satisfactory product are being earnestly studied and should be of assistance to all. The production of semisteel shell promises also to be of interest to the malleable founder as the air furnace is seemingly the ideal unit for producing a high grade and uniform material.

At the Boston convention, last year, the American Foundrymen's association recommended to Secretary of War Baker the advisability of sending to France a selected committee of foundrymen for the purpose of studying methods of semisteel shell and ordnance manufacture. In view of the present call for semisteel production I am very sorry that this recommendation was not acted upon. General Crozier, to whom it was referred, not approving.

The difficulties in the way of successful production of these shell are by no means slight. Had the foundrymen been afforded the opportunity of acquiring first-hand knowledge of the French methods through a representative committee I feel it would have proved of great assistance today.

The production of grenades during the past year has been large. Much credit is due foundrymen for the manner in which shops have turned from altogether different lines to the successful production of grenade castings. The rifle grenade, made of malleable iron, calls for a casting soft enough to be easily machined and of tough composition, clean and sound with the cores centrally located, etc.

Such devices as multiple core boxes, ingenious arrangement of core plates, devices for turning out and handling dry cores, molding machines, short cut methods of ramming and venting, etc., have brought about an average production in some shops of 1600 to 1700 castings per male machine molder per day, with 1200 to 1400 cores per day for each girl.

It is interesting to note that Milwaukee ranks sixth in number of foundries in the United States with a total of 94 as compared with 69 in 1916. In total number of foundries, Chicago is first with 188; New York second with 125; Cleveland third with 115; Philadelphia and Detroit are tied for fourth and fifth places, respectively, with 111, and Milwaukee is sixth with 94.

This association has been active and has been in close touch with the government. The service it has rendered has been thoroughly appreciated. The association's directors, secretary and manager of war service work will furnish interesting reports of its activities.

We can look to the future with great confidence as strict adherence to the policy we have always pursued, the policy of helpfulness to our industry in an educational and advisory way, will be productive of even greater results in the future years.

The presidential address delivered at the opening of the annual convention of the American Foundrymen's association, held in Milwaukee, Oct. 7 to 12. Mr. Fuller, who was president of the association during the past year, is now general manager of the Niagara Electric Furnace Co., and affiliated industries, Niagara Falls, N. Y.

William J. Keep Meets Accidental Death

WILLIAM JOHN KEEP, pioneer investigator of the properties of gray cast iron and metallurgist of international reputation, met accidental death in Detroit on Sept. 30. He was struck by a street car and passed away a few hours later. The foundry industry of the world is greatly indebted to Mr. Keep for his extensive research work which led to the establishment of many principles underlying gray iron foundry practice. He was one of the leaders in the stove foundry industry and he enjoyed marked success in originating new patterns and designs in stove construction. For a period of more than 35 years Mr. Keep was affiliated with the Michigan Stove Co., Detroit, where his unusual technical ability and training coupled with his extensive and varied experience in stove manufacture peculiarly fitted him to occupy an important place in this organization. In a memorial resolution adopted by the board of directors of the Michigan Stove Co. the following reference is made to Mr. Keep. "It was characteristic of him to be most attentive to and faithful in the discharge of his duties and because of his recognized ability in his profession, his even-tempered geniality and unfailing courtesy, he created many warm personal friends among the officers and employes of our organization, who will deeply miss seeing him in his usual daily place." Mr. Keep was a prolific contributor to the literature on foundry practice. When THE FOUNDRY was established, 26 years ago, Mr. Keep's name first appeared in its columns and until the time of his death he contributed freely on various phases of gray iron work. Mr. Keep was born June 3, 1842, at Oberlin, O. He acquired his education in the public schools at Oberlin and graduated from Union College, Schenectady, N. Y., with the degree of civil engineer. After leaving school he was employed for three years by Hubbell Bros., stove manufacturers, Buffalo, and later removed to Troy, N. Y., where he was appointed superintendent of the stove foundry operated by Fuller, Warren & Co. From 1875 to 1884 he engaged in the manufacture of stoves on his own account. For several years during his residence in Troy, he delivered a course of lectures on the steam engine to the senior class of the Rensselaer Polytechnic institute. In 1884 he moved to Detroit to accept the position of superintendent of the plant of the Michigan Stove Co. and subsequently he was appointed consulting engineer for these extensive works.

Throughout his life, Mr. Keep made investigations of the properties of cast iron and other metals. In 1885 he discovered the relation between the shrinkage and chemical composition of cast iron and devised the system of "Keep's Test." which subsequently was termed mechanical analysis. This method of ascertaining the shrinkage of cast iron is used in many foundries all over the world. It was devised from the results of thousands of tests which were described in numerous papers in which Mr. Keep discussed the influence of silicon, phosphorus, sulphur and manganese on the shrinkage and strength of cast iron. Another important contribution to foundry literature consisted of "Keep's Cooling Curves," but his most important publication is "Cast Iron," which made its first appearance in 1902 and of which numerous editions have since been published. At the time of his death he had just completed a paper entitled "Impact" which deals with his latest experiments. Mr. Keep patented many of his devices, one of the most important of which is a system of matchplate molding use in which the roll-up hinge is employed.

Mr. Keep was a member of many technical societies, including the American Society of Mechanical Engineers, of which he was vice president from 1903 to 1905; American Institute of Mining Engineers; Iron and Steel Institute of Great Britain; American Society for Testing Materials; Franklin Institute; Detroit Engineering society, of which he was a past president; fellow of the American Association for the Advancement of Science; honorary member of the Rensselaer Society of Engineers; Philadelphia Foundrymen's association and he was a vice president of the American Foundrymen's association in 1906. The manner of his death was not unlike that of Thomas D. West, who like Mr. Keep was one of the elder group of American foundry leaders to whom credit for so much of the present state of the art must be given. William J. Keep was a brilliant and prominent figure in that small coterie of foundrymen and scientists such as Boyden, West and Outerbridge who were the leading factors in the transformation of the castings industry from the dark mists of rule-of-thumb methods to a scientific basis founded upon definite metallurgical laws. This transformation, splendid as it now is, and to which many brilliant men have contributed, in its early stages demanded a vast amount of research in pure science of the calibre of that given to the world by Newton, Boyle and Thomson in their respective fields. At this great task William J. Keep was constantly and unselfishly at work throughout his fruitful career. Mr. Keep is survived by his widow and two children, Helen E. Keep and Lieut. Col. Henry Keep, constructing engineer in France.

W. J. KEEP

A New Method of Molding Trench-Mortar Shell

Two Castings Are Made in Each Flask—Jarring Machines Are Used and the Production is 350 Shell Per Day

By H Cole Estep

FOR breaking up enemy formations in fortified positions, the trench mortar has proved itself an admirably efficient weapon. In this war most of the fighting has involved mainly the capture of successive fixed positions, and it is in such operations that the trench mortar has assumed an importance which was not even dreamed of in the years prior to the war. If trench mortars are to be used effectively, however, they must be supplied with unlimited quantities of ammunition in the form of efficient trench mortar bombs or shells. These shells are made of a fine grade of gray iron, cast usually in green sand molds. The work in this country has assumed such proportions that an appreciable fraction of our gray iron foundry capacity is now engaged exclusively in the production of trench-mortar ammunition. The government's full program, however, has not yet been disclosed and additional contracts for trench-mortar shell are being let right along.

The manufacture of these projectiles involves problems of peculiar interest to foundrymen patriotically anxious to do their part in the war. The trench-mortar shell are fired from a smooth bore gun rear end foremost. Since the mortar is not rifled, the shells do not rotate like an ordinary projectile, and, therefore, in order to steady their flight, they are provided with vanes on the nose end like feather on an arrow. These vanes, which are made of rolled strip steel, are so fitted and arranged that they are cast integrally with the shell.

FIG. 1—FINISHED TRENCH-MORTAR SHELL AT LEFT WITH GREEN-SAND CORE AT RIGHT

Casting the vanes to the shell in this manner introduces foundry problems of an unusually interesting character. Most of the trench-mortar shell being produced in the United States are of the Newton-Stokes type, shown clearly in Figs. 1 and 6.

Various satisfactory methods of making these shell have been developed in American foundries. In general, it has been found advisable to employ molding machines and to cast the shell nose or ogive down, using gates of the bottom-pour type. The shell may be cast either one or two in a flask and in either case the vanes are bedded firmly in the sand in the drag with only sufficient metal projecting into the mold to fuse the edges of the vane properly with the nose of the shell.

An unusually economical method of making these shell, employing the principles just described, has been developed by the Cleveland-Osborn Mfg. Co., Cleveland. According to the Cleveland-Osborn method the shell are cast two in a flask, nose down using a knife gate which feeds the metal into the bottom of the mold. Metal patterns and 2-part cast iron flasks are employed. The mold is made on a combination Osborn jar-ramming stripping-plate machine, the cope and drag being rammed up simultaneously. The core is made on a separate small plain jar-ramming machine using a split corebox. Figs.

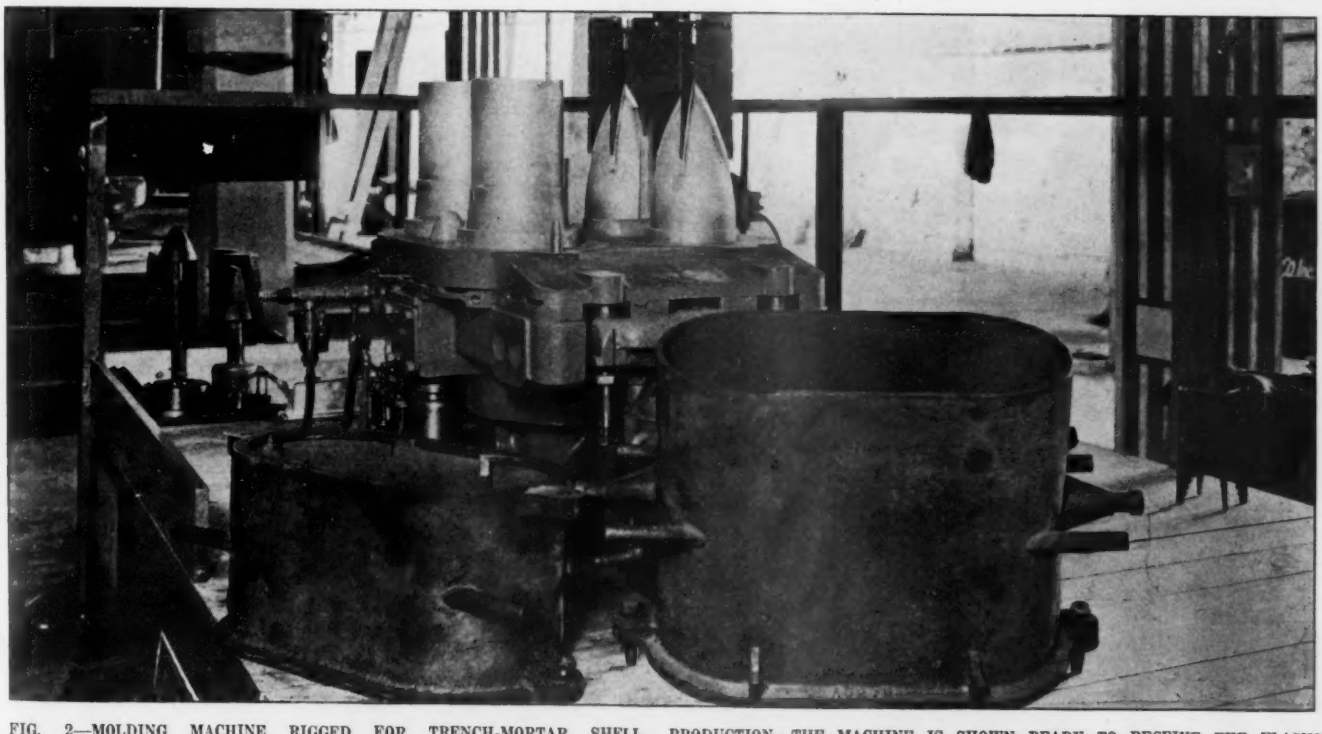


FIG. 2—MOLDING MACHINE RIGGED FOR TRENCH-MORTAR SHELL PRODUCTION—THE MACHINE IS SHOWN READY TO RECEIVE THE FLASKS, THE STEEL GUIDE VANES BEING INSERTED INTO SLOTS PROVIDED ON THE PATTERN

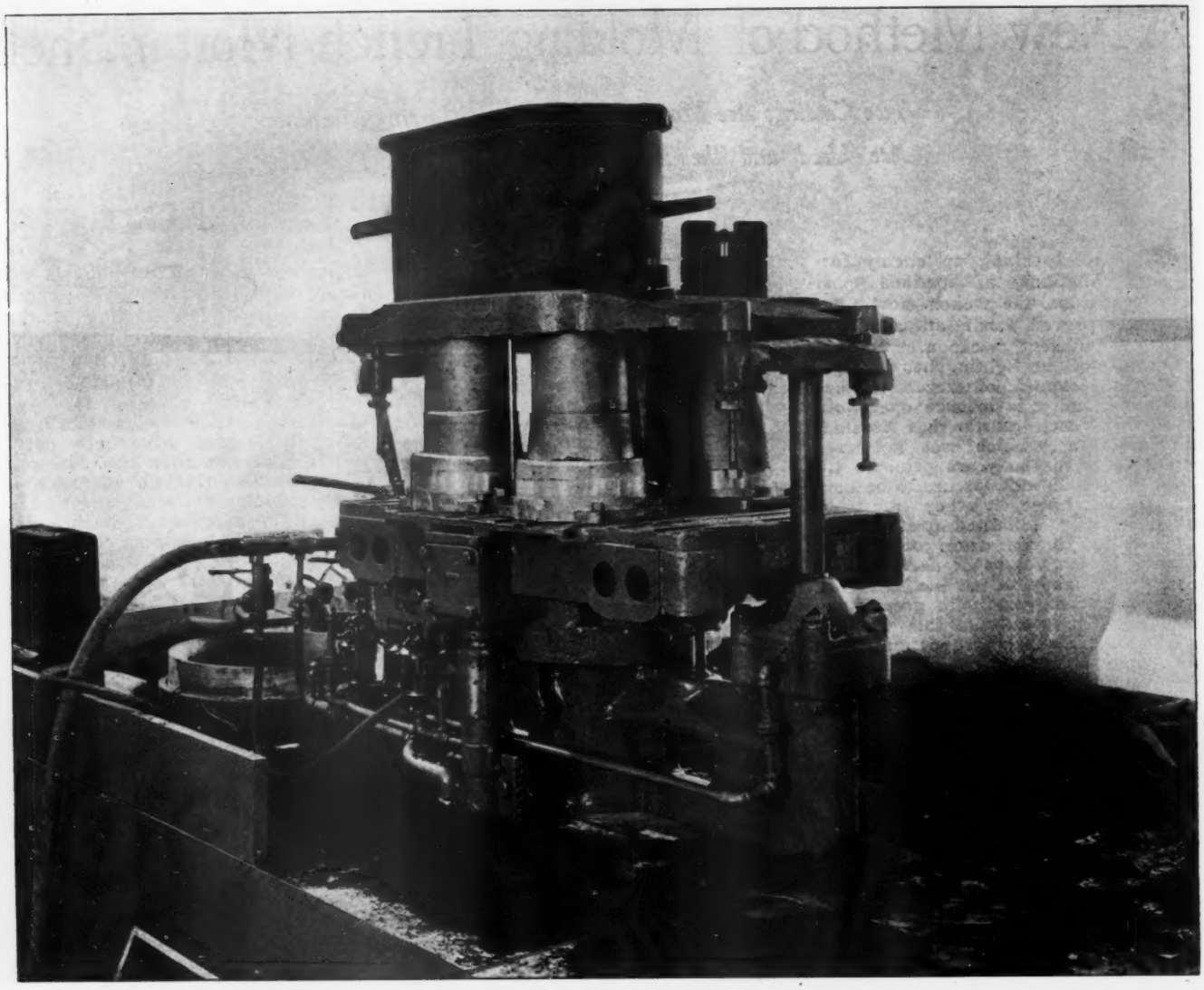
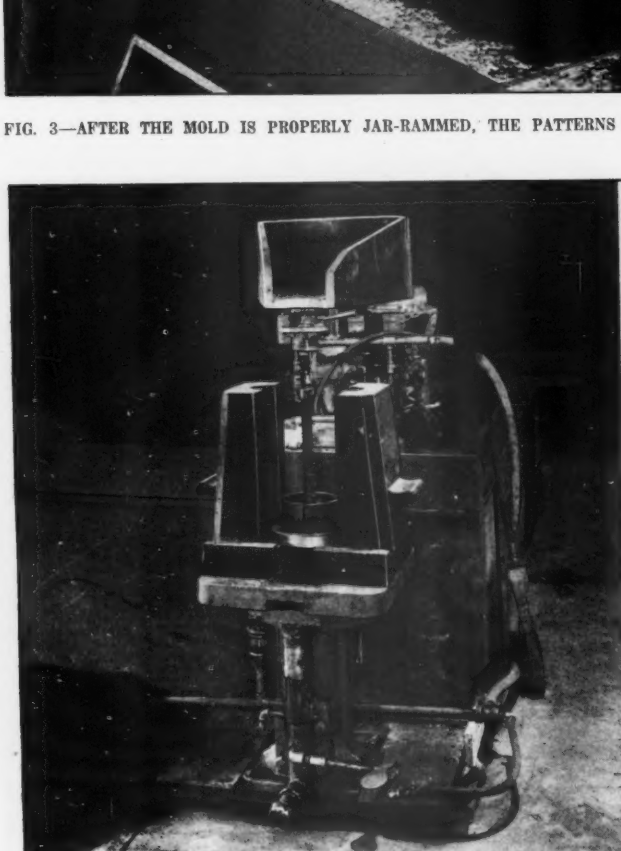


FIG. 3—AFTER THE MOLD IS PROPERLY JAR-RAMMED, THE PATTERNS ARE DRAWN THROUGH A STRIPPING-PLATE AS SHOWN IN THIS ILLUSTRATION



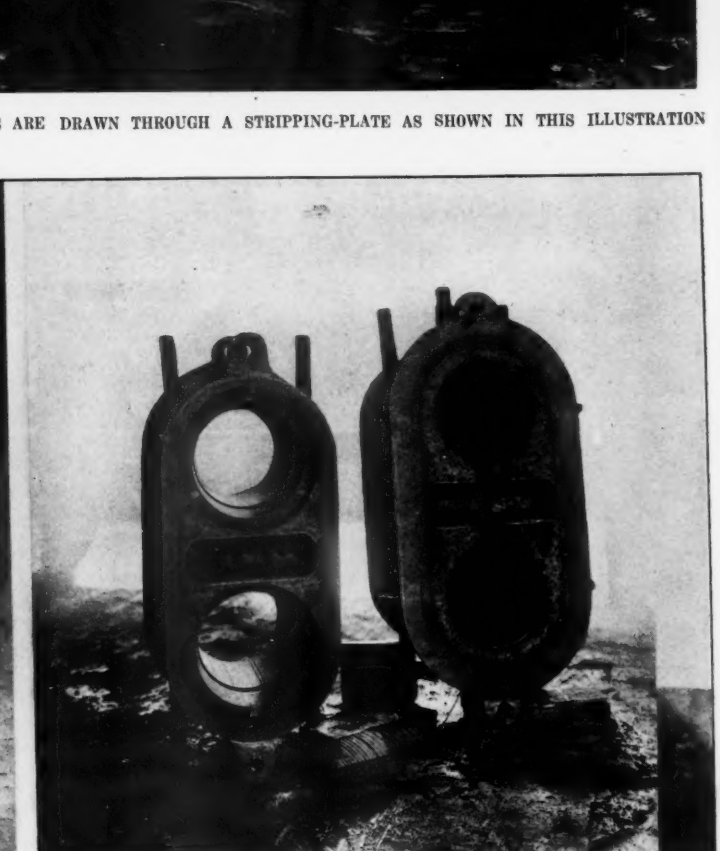


FIG. 4—THE CORE IS MADE ON A PLAIN JAR-RAMMING MACHINE IN A SPLIT COREBOX—FIG. 5—DETAILED VIEW OF THE COPE AND DRAG MOLDS FOR TRENCH-MORTAR SHELL

2 and 3 show the general arrangement of the molding machine, the core machine being illustrated in Fig. 4. This method is in practical use in various foundries and it has been demonstrated that each molding machine can readily turn out 175 molds or 360 shell per day. These shell are 6 inches in diameter and the vanes are 10 inches in length. Although the flask consists only of two parts, a third unit is added to the mold in the shape of a dry-sand pouring basin through which the metal passes into finger and knife gates leading to the molds.

The molding machine, Fig. 2, has a jolting capacity of 1200 pounds and a stripping capacity of 1000 pounds when operating on air at 80 pounds per square inch. The table of the machine is 19½ x 36 inches, the area inscribed by the lifting pins being 11½ x 35½ inches. The pattern draw for this job is 14 inches. The jolting cylinder is 6½ inches in diameter and the machine is designed to use 6.5 cubic feet of free air per mold. The details of the machine are clearly illustrated in Figs. 2 and 3.

The cores, as previously mentioned, are made in a split core box on a plain jolt-ramming machine provided with a table 18 inches square. The cylinder of this machine is 3½ inches in diameter, the jolting capacity being 475 pounds at 80 pounds per square inch air pressure. This machine, which is illustrated in Fig. 4 is designed to use 1½ cubic feet of free air per mold.

Cast Iron Patterns Used

The patterns, as shown in Fig. 2, are cast iron, machine finished. They are arranged on plates which are securely bolted to the table of the machine. Each pattern is divided into two parts, one part forming the nose end of the shell carrying the vanes, and the other the butt. A riser with a diameter equivalent to that of the shell and with a length approximately equal to the diameter is employed.

The flasks are cast iron of sturdy construction, oval in shape, as shown in Fig. 2. Suitable flask pins, trunnions and handles are provided. The flanged faces of each flask are machined to an accurate surface. The two parts of the flask, therefore, fit together accurately and each part also fits on the table of the machine during the molding operation. The drag is 19½ inches long, 8⅜ inches wide inside and 16¾ inches deep. The cope, which has the same length and width as the drag is 10½ inches deep.

The core can be made in either of two ways. The recommended method is to make it of green-sand on a gas-pipe arbor, the green-sand being held in place when the core is suspended in the mold by a dry-sand nose, or if preferred, the entire core may be dried. Usually, however, this is not considered necessary for trench-mortar shells. The core hangs nose downward in the mold on the arbor, being securely held in place and centered by a machined base plate into which the arbor is screwed. This base plate is shown clearly under the core at the right in Fig. 1 and the recess in the mold in which it fits is illustrated in Fig. 5.

The core arbor consists merely of a gas pipe into which small plugs or splines are driven to hold the sand. The arrangement of these splines is clearly shown in Fig. 4. The gas pipe also is drilled with holes to carry away the gases formed in the mold. A ¾-inch gas pipe is used, the core arbor being 13¾ inches long. The core itself is 15 inches in length and 5 inches in diameter. It is made in a split corebox of the general type shown in Fig. 4; if a large number of cores are required this box should be of metal instead of wood. An arrangement for filling the box with sand from a suspended hopper also is illustrated in Fig. 4. The cores can readily be made by one man as rapidly as the molds are turned out on the larger machine.

The operations involved in making a mold are relatively few and simple. At the commencement of the work the machine appears as shown in Fig. 2, the steel vanes being fitted into recesses provided on the patterns as indicated. As soon as the vanes are in place, the two parts of the flask are set over their respective sets of patterns and filled with sand and rammed. After jolting the patterns are stripped out of the mold as shown in Fig. 3, this machine being so designed that the stripping plate carrying the flasks rises, the patterns remaining stationary on the jolting table. The molds as they come off the machines are shown in Fig. 5. At the right, the noses of the shell are illustrated and the method of bedding the steel guide vanes in the sand is clearly indicated. This illustration also shows the arrangement of the finger gate with ½-inch fingers or runners which lead the metal from the pouring basin to the skimming basin formed in the parting between the cope and drag. From the latter the metal is conveyed into each mold through a knife gate which conforms to the contour of the nose of the shell. This gate is shown in the background in both Figs. 2 and 3.

Six operations are involved in making each mold. These operations are as follows:

No.	Operation.
1	Dust off pattern and fit flask to stripping table.
2	Riddle sand on pattern.
3	Fill flasks with heap sand.
4	Jar-ram, bumping the flasks from 80 to 100 times —No tucking is necessary.
5	Butt ram the tops of the molds.
6	Draw patterns.

There are only three subsequent operations; namely, closing the mold, setting the cores and placing the dry-sand pouring basin in position. Both flasks are filled with sand at one time, a shield of sheet metal being employed to guide the sand from the drag to the cope and to prevent it from falling between the two parts of the flask onto bed of the machine.

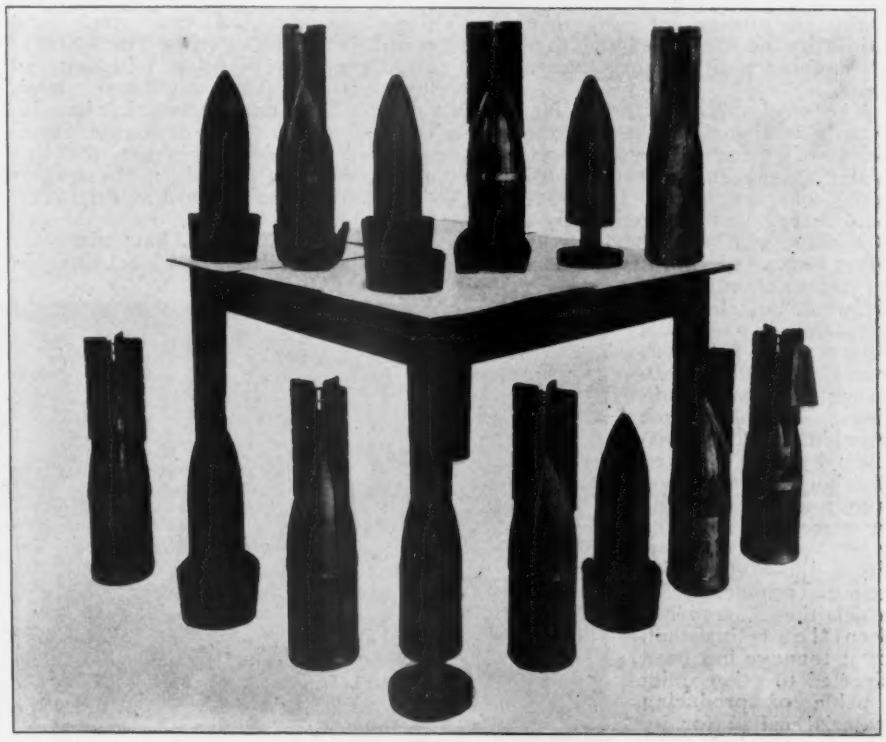


FIG. 6—A GROUP OF TRENCH-MORTAR SHELL WITH CORES SHOWING CONSTRUCTION

For pouring the molds, a high grade gray iron mixture should be employed with only sufficient silicon to insure proper machining qualities. A small amount of steel may usually be used in the mixture to advantage. Ordinarily it should not exceed 10 or 15 per cent. The metal should be melted carefully under laboratory control and poured as hot as possible. The shell may be cleaned either by tumbling or sand blasting.

T. P. Kelly & Co., New York, manufacturers of foundry facings and supplies, have established a branch warehouse at Worcester, Mass., in charge of Clarence F. Berg.

The Gardner General Foundry Co., Gardner, Mass., has posted notices that no one shall enter its employ unless he has purchased one or more bonds of the fourth Liberty loan.

Sale and Distribution of Foundry Pig Iron

How the War Industries Board Handles the Problem of Distribution of This Vital War Element—Precautions to Prevent Waste Are Demanded

By C J Stark

WAR has put normal foundry business in the discard. No major section of the iron and steel industry has been so extensively dislocated by the transition of the United States from a peaceful to an aggressively belligerent nation, as the casting industry, particularly in its chief branch, gray iron. It would be difficult throughout the length and breadth of the country today to find many shops which are turning out work they were originally built or designed to do; or were doing a little more than a year ago.

The steel mills are producing shell rounds and shell billets by the millions of tons. They are yielding plates at the annual rate of 6,000,000 tons, whereas before the war their best record was approximately 3,700,000 tons yearly. They are rolling other lines of finished material at a tonnage rate far different, both less and greater, from that shown in previous years or under ordinary business conditions. This has been brought about primarily by an altered division of raw steel supply and secondarily by some new mill and steel works capacity. From those mills finishing products for which the demand has been less insistent, ingot tonnage has been diverted to other units capable of producing material called for by the most vital purposes. This largely has been a process of adjustment and of accommodation to a new line-up of demand. It has been facilitated by the virtually permanent condition in the steel industry of an excess of finishing mill capacity over steel works output; likewise by the range of operations possible on certain types of mills. Thus, the rail and and structural shape mills as well as the merchant bar mills have been turned to the rolling of large rounds for projectiles and much of that steel which ordinarily would have gone into rods for wire products, into sheet bars for sheets and into small billets for merchant bars, or other finished products, has been put into slabs for plates, into large billets for shells or into some form to suit the particular requirements of war. It has been a question of speeding up the production of this or that product to the utmost point which has been made possible by a maximum and continuous supply of raw steel; and contrariwise by putting the brakes on the output of other mill material less essential from a tonnage standpoint. This on the whole, has involved no radical departure from standard practice; or from the line of manufacture for which the respective plants were established originally. War demands plates, rails, sheets, wire, structural shapes, bars, tin plate and virtually all finished steel lines, as well as peace, though in different proportions.

With the foundries, however, it has been an entirely different situation. Modern war does not require castings to the extent or in the form demanded by the pursuits of peace. Furthermore by its intense absorption of such basic materials of production as pig iron, scrap, coke, coal, etc., it imposes restraints upon everyday civil life and cuts down normal consumption. The result is a surplus of foundry capacity which if it is to be maintained and to prove itself of use in the big test of national service, must adapt itself to the new conditions and must fit itself for the things that are within its power to perform. And this is often proves is no easy task. War is a minute science and its standards are high. It demands the satisfaction of exacting chemical and physical specifications; the enforcement of rigid inspection methods and a general preciseness of practice which the majority of casting manufacturers seldom are called upon to observe in normal operations. This usually means for the average foundryman new equipment, new methods and more or less reorganization of his shop, both as to the personnel and as to the co-ordination of the processes of production. It frequently requires extensions of capacity. In some cases, entirely new plants have been erected to make a specific war essential, such as grenades, ship castings, tractor parts and other lines. All of this involves not only initial plant expense and increased overhead, but delays, losses and difficulties of production which are incident to the undertaking of any new line of output. It requires little imagination to grasp the sweeping changes that must have taken place to put a stove foundry, a cast shell made to an ordinary jobbing plant on a basis where it may successfully turn out in quantity, cast shell made to milimeter dimensions. Such a transformation indicates the radical

C. J. STARK

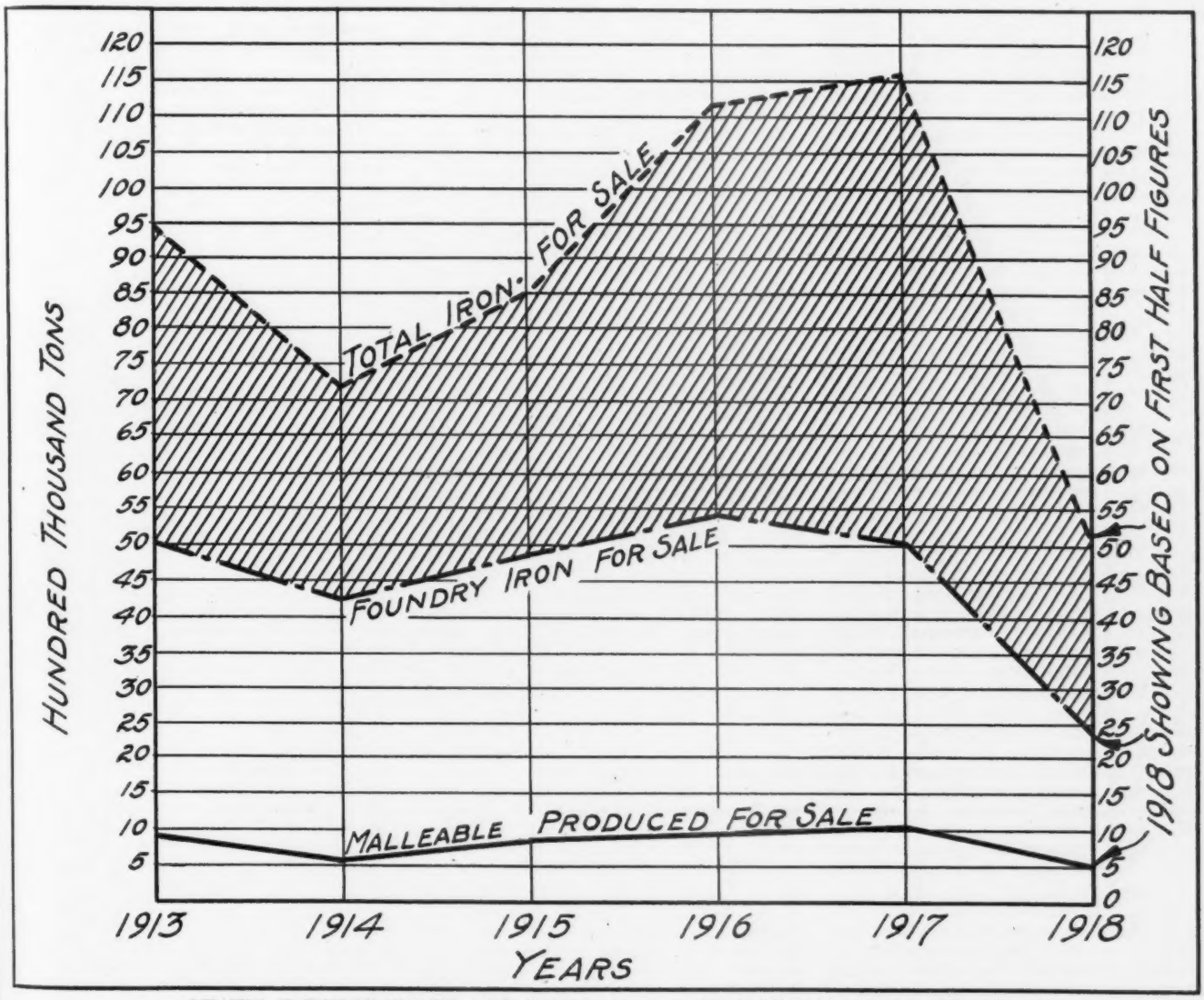
A paper presented at the Milwaukee convention of the American Foundrymen's Association. The author, C. J. Stark, is editor of The Iron Trade Review, Cleveland.

readjustment which actually has been taken place in many parts of the foundry industry today, and as a result of which the striking power of the nation has been materially increased. It should be a source of gratification to the whole country and a mark of credit to the initiative and spirit of the industry that many casting plants have responded so promptly and well to the nation's call.

But as the situation has developed, it is becoming more and more evident that the foundryman is acting with little choice in the matter. His is and promises to become more so, a real and vital problem. It is not too much to say that the existence of many plants for the near future, at least, is at stake. Only by the foundryman engaging in the casting of some products entering into the needs of war or into those channels of consumption which are deemed essential to public interest under wartime conditions may he assure himself of those elements of industry without which he cannot operate. Every announcement and move at Washington by those in control of war industry clearly has revealed this fundamental condition. These elements of industry are described as labor, capital, facilities, material, transportation and fuel. The war industries board under date of Sept. 7 issued what is described as the "master key" governing the requirements of present industry. This is known as Preference List No. 2. It defines essential industry and classifies it according to its relative importance. In effect it distinguishes between what is essential and what is not essential in industry under prevailing conditions. It will serve as a guide to foundrymen in settling for themselves the troublesome question as to what does and what does not constitute essential work and it should be consulted carefully by all manufacturers.

The key to the foundryman's position at the present time is his supply of pig iron. Only by getting his plant on war and essential work may he be able to count upon a supply of this indispensable material; and then only to the amount of iron required by the percentage of his capacity that is so engaged. In other words, such requirements as arise from specific war or essential work are being supplied. Beyond that, no assurance of material is held out by the government authorities. The course of wisdom for the average foundryman is obvious. The steel director, in whose charge is the present distribution of pig iron, has repeatedly sounded the extreme need for the strictest conservation of pig iron and the necessity of every foundryman so altering his accustomed practice as to permit of that economy. The pig iron supply of the country is short, considerably so. There is no possible way by which the tonnage lacking can be made up. This stringency and the general labor situation, point to materially reduced production by the foundries as the war goes on. The more liberal use of scrap in mixtures is not likely to offer much permanent relief since the supply of cast and other cupola metal is shrinking and replenishment of stocks by the yards and dealers is becoming more uncertain; furthermore the growing shortage of labor makes it more difficult to sort the considerable amount of scrap which comes on the market in a mixed condition. In the steelmaking grades of scrap, the shortage of supply already has become acute.

Allocation is a word of which we are hearing a great deal today, but its significance and the workings of the system that it represents are not always clearly understood. An allocation is an order and it is primarily applied to raw material rather than to manufactured articles. Thus we have allocations of pig iron and steel which are regarded as basic materials. It would be well not to go too far into the technical phases of the



RELATION OF FOUNDRY IRON FOR SALE TO TOTAL OF ALL GRADES PRODUCED FOR THE MARKET SINCE 1913

rather complex machinery of the government for regulating the flow of essential materials except to say that no priority ratings are given to different demands for pig iron because that metal is put at the root or starting point of industry and the supply is to be so distributed or husbanded as the imperative demands dictate.

The primary function of the pig iron section of the division of steel supply of the war industries board is to procure pig iron for governmental orders. A manufacturer having been given a government order for certain material and feeling that the tonnage of pig iron which he has in stock and on order is insufficient to enable him to complete this work, applies to the department which placed the order or to the director of steel supply, for such additional quantity of iron as will enable him to carry out his contract.

Should the application come to the director of steel supply, it is referred to the proper government department which has, or will secure through investigation, the data necessary to enable it to make a request for an allocation of the amount of pig iron needed. To determine the proper tonnage full information is secured as to the weight of the castings required to complete the contract; the amount of iron the manufacturer has in stock, in transit or on order; the analysis preferred; the usual source of supply; and the percentage of scrap normally used by the manufacturer.

Who Passes Judgment

This information is carefully considered by the government department which then makes a formal request on the director of steel supply for the tonnage of pig iron considered necessary, submitting with the request confirming data. The case is then considered by the pig iron division which has in addition to the information submitted by the government department, data secured from the questionnaires returned by the producers, from personal interviews with various manufacturers, from investigation and from various other sources. All these facts are taken into account in arriving at a final decision. In certain cases it has been found that the manufacturer was not entitled to an allocation as he had sufficient iron on order and merely needed assistance in having it shipped. There have been cases where allocations were refused on the ground that the manufacturer would be able to fill his contract from his own iron if he would conserve it by using a proper proportion of scrap in his mixture. In this connection it may be stated that aside from performing valuable service in conserving pig iron and properly distributing the available supply, the pig iron division is doing considerable educational work. This is accomplished by eliminating many of the old rule-of-thumb methods of the foundries dating back to the days when iron was graded by fracture instead of analysis; and by showing the foundrymen how they can make advantageous changes in their practice. This latter course includes increasing the amount of scrap used, combating the idea that four or five brands of iron are necessary to make up a mixture, discouraging the extravagant use of higher silicon iron, etc. It is pointed out that these methods will help the foundrymen to hold their organizations together and protect their invested capital, should it become necessary to reduce the supply of foundry iron.

The amount of pig iron required by the manufacturer under consideration having been determined, a regular allocation request form is made out by the pig iron division and is sent to the committee on pig iron, ore and lake transportation of the American Iron and Steel institute which has headquarters at Cleveland. The latter suggests the furnace which is to furnish the tonnage.

Trade Customs Respected

It is the intent and endeavor of the director of steel supply to upset trade customs and usages as little as possible. On receipt of the allocation request, the local committeemen of the district in which the manufacturer for whom the iron is to be secured is located, make every effort to place the order with the furnace which has usually served the particular user unless such an allocation would involve cross haulage or some similar circumstance. But should the furnace in question have so many allocations that it cannot accept further tonnage, the committeemen then endeavor to place the allocation with the furnace most conveniently situated to supply the manufacturer's needs. In such cases, due consideration is paid to the various phases of the railroad situation, the rate of freight, similarity of the iron to that ordinarily used, time required for delivery and other conditions. There have been cases, however, when it was impossible to observe the conditions outlined as when the grade of iron needed could only be supplied from another district. In such cases the question of supply has been considered paramount to all others.

The furnace to receive the order having been determined, the director of steel supply is notified. After he authorizes the allocation, the manufacturer is advised either by the government department for the completion of whose order the iron is needed, or in certain cases where the pig iron section has requested the allocation, by the director of steel supply, that he may send his regular formal order to the designated furnace. The order calls for specified tonnage and grade of iron which is to be shipped at a prescribed rate. Accompanying this notification is an "authority" from the government department or the director of steel supply which serves to give the furnace assurance of the governmental validity of the manufacturer's order.

In cases where iron already ordered by the manufacturer is needed for the completion of government work, the director of steel supply instead of allocating, upon presentation of proof that the iron is required for governmental purposes writes the furnaces direct "ordering in" the iron. These instructions have all the weight of an allocation. Like an allocation, shipments under such instructions have preference over any other shipments even though every other order on the furnace books as developed by the questionnaires, is shown to be for 100 per cent governmental purposes.

Much has been said and written as to this being a war of steel. Rather it might be said it is a war of ingots instead of one of castings. At least it has been such for some months, though the situation now is undergoing considerable change.

Germany, to all reports, has been putting to good use her foundry capacity for the production of primary war material. This is in the making of cast shell. This country proposes to do likewise. In the tremendous semisteel shell program which the war department now is unfolding, there is an opportunity opened to miscellaneous foundries to materially increase their direct participation in war production and their standing as plants of the preferential class entitling them to pig iron and other essentials. The program as now outlined calls for a total of 33,000,000 of 3, 4.7, 6 and 8-inch shell. It is estimated that these orders ultimately may take up 25 per cent of the capacity of the casting plants of the country. At least 1,000,000 tons of metal are involved which on the basis of the usual semisteel mixture would mean 600,000 to 700,000 tons of pig iron and 300,000 tons of scrap. Malleable as well as gray-iron shops now are preparing to engage in the making of semisteel shell on a big scale.

Foundry Showing Increases

It would be difficult to estimate the actual percentage of foundry capacity that now is engaged in turning out direct or indirect war work. Six months ago, it was a comparatively meager total. Questionnaires returned by foundry consumers to the furnaces in May made a low showing on direct war work. This ran from about 10 to 25 per cent. The indirect war demands, however, were considerably larger. It is doubtful, however, whether at that time more than 50 per cent of melting capacity was taken up by orders in any way related to war. Since then the foundries have been more active in putting their facilities at the disposal of the government and in determining what portion of the war program they could fit themselves to do. The result has been a steady increase in war work among the casting plants. This is reflected by the figures of iron allocated by the committee on pig iron, iron ore and lake transportation during the past five or six months. Out of 1,052,000 tons allocated since May 1, 292,000 tons have been of foundry grade. This is the largest tonage for any single grade excepting basic with 420,000, and is in fact in excess of the latter as far as domestic consumption is concerned. This is because the basic so placed included 180,000 tons of basic for the British government. Allocations of malleable iron since May were 109,000 tons and of low phosphorus iron, 109,000 tons. With but minor exceptions all this iron is for delivery this year.

These increased allocations of foundry iron also tell another story. They reveal the growing difficulties of the foundry users in obtaining their supplies from their usual sources. This is due to the shrinking production of foundry iron. More unfilled

tonnage of foundry iron is on the books of sellers today than in any other grade. This largely was entered by the usual route of open market purchases before the government took a close grip upon distribution. When it can be delivered, if at all during the period of the war, is a question.

Production of pig iron in 1918 was begun with an estimated shortage of over 500,000 tons. This was occasioned by the severe weather conditions and the freight tieups which seriously affected the operations of the furnaces in November and December. These conditions continued through January and February and by March 1 the estimated shortage stood at over 1,500,000 tons. It was appreciated by those who analyzed the situation that the foundries, especially those in the gray-iron class, were likely to suffer severely from the shortage. This was because the heaviest and most pressing war demands being for steel, it was realized that the production of steelmaking pig iron would be favored and that as far as possible, the loss of tonnage would be made up by switching more furnace capacity to these grades. This meant that a number of stacks producing foundry iron would be changed over. This is exactly what has happened.

Furnaces Switch Output

Under a growing shortage of steelmaking iron, especially basic, this transposition from foundry, bessemer or malleable, to basic production by the merchant furnaces has been marked. Probably not less than a dozen furnaces have been changed over since this country went to war. At Cleveland six stacks, of which at least four had been making foundry or malleable for sale, now are all making basic. The production of foundry iron in the Chicago district has been cut down materially by the same cause; a similar condition has been shown in the Mahoning and Shenango valleys, in southern Ohio and in eastern Pennsylvania. In Alabama, three companies are producing portions of an order for 80,000 tons of basic allocated to them for England which is to go to the repayment of iron and steel borrowed from the British government by General Pershing for the American Expeditionary Forces. Recent years have witnessed the increasing union of merchant blast furnaces with steel works which were rounding out their sources of pig iron supply and this has brought about some contraction of the tonnage of iron made for the market, including a liberal amount of foundry iron. The apparently insatiable demands for steel from this country since it engaged in the world war, however, have been responsible for the accelerated increase of basic iron production at the expense of other grades.

In considering the prospects of the foundry industry as to future pig iron supplies, it is well to review iron production in this country since the world war began.

The output of foundry iron in that period has not kept pace with general production. In 1914, of the total tonnage of iron made for sale by the blast furnaces of the country, 59.7 per cent was of the foundry grade. This represented an increase from 53.4 per cent of the merchantable iron made in 1913. In 1915 this proportion had dropped to 55.9 per cent, in 1916 to 48.6 per cent and in 1917, nine months of which found the country at war, to 44.4 per cent. In the first half of 1918, however, it rose to 47 per cent.

The relation of foundry iron made for sale to the total of all grades produced for the market since 1913 is as follows:

Year	Total Iron for sale tons	Foundry Iron* for sale tons	per cent
1913	9,523,885	5,084,952	53.4
1914	7,362,980	4,393,089	59.7
1915	8,583,007	4,801,711	55.9
1916	11,253,317	5,473,196	48.6
1917	11,676,513	5,186,498	44.4
1918 (First six months)	5,226,245	2,458,412	47.0

*These figures also include ferrosilicon and almost all the charcoal iron made in the country.

The record of malleable iron has been more irregular. It shows both decreases and increases during the war period. Its relation to total production made for sale is as follows:

Year	Malleable produced for sale tons	Percentage of total merchant iron
1913	989,241	10.4
1914	671,771	9.3
1915	829,921	9.7
1916	921,486	8.2
1917	1,015,579	8.7
1918 (First six months)..	563,279	10.8

During the first half of 1918, foundry iron produced for sale fell off 90,377 tons from the first half of 1917, and 179,279 tons from the last half of 1917. The rate of foundry iron produced for sale to the total amount of iron made for the market during the first half of 1918, however, it will be noted, increased to 47 per cent. This increase was due to the fact that the output of iron made for sale in all grades during the first six months of 1918 declined at a higher rate than in foundry iron.

Against the first half of 1917, the six months loss in merchant iron of all grades was 458,544 tons and against the second half of 1917, 765,479 tons. In looking for an explanation for this, it is found in the tonnage of bessemer iron made for sale. A loss of something like 400,000 tons in the bessemer made for the market during the first half of 1917 and of 500,000 tons during the last half of 1917 is shown by the figures for the first half of 1918. This precipitate drop in bessemer is the sequel to the abnormal increase in the demand for this grade which was the basis for the rapid expansion of the export trade in pig iron of this country in 1916 and 1917. In 1916 we exported 607,236 tons of all grades and in 1917, 653,931 tons as against 277,648 tons in 1913. Our exports now are running at about 200,000 tons annually.

The dominating feature of the production statistics for the first half of 1918 is that basic iron output, notwithstanding the reduced operating capacity at the start of the year, has held its own. The total of this grade produced in the first half of 1918 was 8,617,692 tons against 8,620,604 tons in the first half of 1917 and 9,051,058 tons in the last half of 1917. It is apparent that in overcoming the loss in basic output occasioned by the low rate of operations at the beginning of the year, bessemer and foundry capacity was utilized. The conclusion is plain that basic production has the right of way and will be maintained at the expense of other grades, as necessary.

The significance of the comparisons shown of the production statistics from 1913 to 1918 is this: The demands for foundry iron have not increased in anything like the proportion as steelmaking iron, particularly basic. While the total tonnage of iron of all grades made for the market increased by over 22.6 per cent between 1913 and 1917, the proportion contributed by foundry iron declined approximately 9 per cent. In the same period the total output of all blast furnaces, that is both steel works and merchant stacks, expanded from 30,966,152 tons to 38,620,967 tons or 24.7 per cent. The relation of the foundry iron made to the total production in the same period declined from 16.8 per cent to 13.4 per cent. It is well to point out here that all but a negligible quantity of foundry iron which has been produced in the country in recent years is for sale, or to put it another way, all the gray iron foundries of the country buy their metal in the open market.

Where Scrap Comes In

The relative decline in foundry iron production since 1914 necessarily does not mean a falling off in the output of gray iron castings in the war years. The number of gray iron shops in the United States in fact increased from 4267 in 1916 to 4325 in 1918. The missing factor is supplied by the scrap consumed. There is no way of ascertaining how much scrap went into foundry mixtures during these years. Basing an opinion on the usual practice and existing conditions, however, it is safe to say that the proportion of scrap to pig iron was materially increased. This is because a high market for pig iron always operates to swell the amount of comparatively lower-priced scrap the foundryman puts into his castings. In 1914 and 1915 there was a low market on both iron and scrap. In 1916 the market for No. 2 foundry at Chicago and at Birmingham registered an advance of from $9.50 to $12.50 per ton and No. 1 cast at Chicago and in eastern Pennsylvania from $2 to $4.50 per ton. In 1917 occurred the climax of the phenomenal rise in prices. No. 2 foundry at Chicago went to $55 and at Birmingham to $50. No. 1 cast rose to $31 at Chicago and to $38.50 in eastern Pennsylvania. These comparative prices without doubt tell their own story. It will be well to bear in mind in this connection that the supply of scrap today is short as well as of pig iron which means less freedom to regulate mixtures.

All statistical studies of pig iron production and of the irreducible demands both for waging the war and for the maintenance of national life, point in only one direction. They emphasize the uncertainty and the instability of the position of the foundry industry taken as a whole.

(*Concluded on page* 537)

Institute Discusses Conservation of Metals

Members Show Interest in Growing Movement to Reduce Consumption of Various Metals, Particularly Tin—New Uses for Old Alloys

WHAT is officially known as the 118th meeting of the Institute of Metals division of the American Institute of Mining Engineers, opened Tuesday, Oct. 8, at 11:30 a. m., in Kilbourn hall, Milwaukee Auditorium. This division was formerly the Institute of Metals, the meeting being held, as usual, in conjunction with that of the American Foundrymen's association. A number of valuable and interesting papers were presented, largely on the subject of metallurgy. A special feature of the meeting was the symposium on the conservation of tin which occupied one entire session.

The presidential address dealt largely with the recent affiliation with the American Institute of Mining Engineers and was followed by the report of the secretary, which touched on the same subject. A paper by Zay Jeffries, Aluminum Castings Co., Cleveland, on the "Metallography of Tungsten", proved of great interest and provoked considerable discussion. There appeared to be a considerable divergence of opinion, both written and oral, concerning the theories advanced by Mr. Jeffries to account for the brittleness of tungsten in the ordinary state as contrasted with its ductility when worked. Paul D. Merica, bureau of standards, Washington, paid tribute to the value of the paper, as did also several other members.

Tests of Babbitt

A paper by Jesse L. Jones, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., on "Notes on Babbitt and Babbitted Bearings", described tests at progressively increasing temperatures of representative lead-base and tin-base babbitts which show that the former have superior resistance to deformation at the usual working temperatures of bearings. The paper described how the metals were shaped and treated to prepare them for the tests, and included a description of a process and a tool adapted to produce smoother and more accurate surfaces on bearings than has previously been possible to obtain. Some of the experiments that have been carried out by the author and which have shaped the conclusions arrived at in the paper were detailed.

In the discussion that ensued, G. H. Clamer, Ajax Metal Co., Philadelphia, pointed out the value of this paper from the standpoint of tin conservation. He stated that about 16,000 tons of tin are annually consumed in the production of white metals, which include such alloys as "genuine" babbitt and that the tests which Mr. Jones had made showed that the common lead-base babbitts were superior to the tin-base babbitts for many purposes for which the latter have been exclusively used. The paper also showed that the addition of small amounts of lead to tin-base babbitts is an advantge, instead of a disadvantage and that there was no need for drawing up specifications for these alloys limiting the percentage of lead to fractions of 1 per cent. It has been quite well established that lead up to 10 per cent improves these alloys. Experience has shown that the best bearings are composed of a bronze back faced with a thin lining of babbitt metal, as such a combination is difficult to distort. Mr. Jones, in reply, pointed out that one reason tin-base babbitts are preferred is that they flow with great fluidity when in the molten state, which is a great advantage when large bearing surfaces have to be covered with a thin layer of babbitt. The lead-base alloys require greater care and considerable skill to apply in such situations, but when this is available they can be used satisfactorily both from the viewpoint of serviceability and of cost.

New Institute Officers

Chairman:
W. M. CORSE,
Buffalo.

Secretary:
FRED L. WOLF,
Ohio Brass Co.,
Mansfield, O.

Vice Presidents:
W. B. PRICE, Scovill Mfg. Co., Waterbury, Conn.; GEORGE K. BURGESS, Bureau of Standards, Washington; HAROLD J. ROAST, James Robertson Co., Ltd., Montreal, Que.; C. H. BIERBAUM, Lumen Bearing Co., Buffalo; SIR ROBERT A. HADFIELD, London, England; W. K. FRANK, Damascus Bronze Co., Pittsburgh; O. H. MATHEWSON, Sheffield Scientific School, New Haven, Conn.; ZAY JEFFRIES, Aluminum Castings Co., Cleveland; W. H. BASSETT, American Brass Co., Waterbury, Conn.

The report of Secretary Fred L. Wolf, Ohio Brass Co., Mansfield, O., showed that the membership of the institute on July 1, 1918, included an active membership of 337 and an associate membership of 49, making a total of 386. The most important feature of the past year, the secretary pointed out, was the affiliation of the institute with the American Institute of Mining Engineers which began July 1. The institute of metals division retains its identity, elects its own officers as previously, and holds meetings with the American Foundrymen's association. In addition, another meeting will be held in February of each year in New York in conjunction with the American Institute of Mining Engineers.

In discussing the paper contributed by S. L. Hoyt, University of Minnesota, Minneapolis, entitled "The Constitution of the Tin Bronzes", C. H. Bierbaum pointed out the influence of the hard and the soft constituents of the alloy in adapting it to bearing purposes. He agreed largely with the theory expressed in the paper as to the constitution of these alloys.

Two interesting papers, "Oxygen and Sulphur in the Melting of Copper Cathodes," and "The Relation of Sulphur to the Overpoling of Copper," were presented by S. Skowronski, Raritan Copper Works, Perth Amboy, N. J. In the course of the discussion, G. H. Clamer remarked that these papers were an important contribution to brass foundry literature, as they illuminated several of the problems usually encountered in making castings such as porosity and the black discoloration often attributed to the presence of iron, but which may in reality be caused by sulphur. The effect of sulphur on brasses and bronzes, he stated, is not well known. Sulphur appears to be less detrimental when oxygen is absent.

Another interesting and timely paper, "Pure Carbon Free Manganese and Manganese Copper," was submitted by Arthur Braid, New York. In the discussion, G. H. Clamer mentioned that he had used manganese copper for the purpose of eliminating sulphur in alloys and had found it to work well when melted in crucibles, but for reverberatory furnace it left much to be desired as a scavenger of sulphur.

How Tin is Being Saved

The symposium on the conservation of tin was both interesting and instructive. The first paper presented was on "Bronze Bearing Alloys", by G. H. Clamer, in which the history of the introduction of lead into bearing bronzes was reviewed and the advantages resulting from its use were discussed. All such alloys, however, contain tin, which increases the interest in the possibility of substituting alloys of an entirely different type, but it should be borne in mind that a bearing metal must be sufficiently rigid to support the load under shock without easily cracking, and still be plastic enough to conform to the moving surfaces. The ideal structure combines a hard matrix to support the load, with a softer alloy contained within this matrix that will enable the bearing surface to adjust itself to any surface irregularities of the moving shaft. It must also be easy to handle in the foundry and machine shop, be capable of being remelted without deterioration, be able to take a tin coating, and have good heat conductivity so the heat generated by friction will be rapidly dissipated.

A practical paper followed on the subject of the antifriction and other alloys that have been adopted by the Pennsylvania railroad, which was presented by H. M. Waring, Altoona, Pa., and outlined some of the methods evolved by this company to hold its tin consumption to a minimum. The approximate composition of the

nonferrous alloys in general use by this railroad is shown in the accompanying table.

Phosphor bronze is used principally for rod bushings, main rod brasses and crosshead shoes. Ex. B. bronze is used to a small extent for backs of car and coach bearings, but the majority of these are now made of the car journal bronze which contains on the average about 5 per cent of tin.

Car journal bronze is used for making car and coach bearing backs of car and coach bearings, by melting down old backs, after removing the linings and making the necessary addition of new metal to bring the composition within the limits given above.

Formerly the lead-base linings of car bearings was melted off and brought up to requirements by additions of new metal as required, but lately as this metal contains some tin, it is being used in making dandelion metal thereby conserving the tin.

Dandelion metal contains about 10 per cent tin, and is used for lining crosshead shoes, engine truck and trailer bearings, hub liners, etc., and its use eliminates a large amount of tin-base babbitt.

Bell metal is used for locomotive bells, and during 1917 about 42,000 pounds of castings were made of this type, involving the use of a little over 7000 pounds of tin.

The use of tin-base babbitt has been greatly restricted, and every effort is being made to replace it with lead-base babbitts.

The amount of solder containing 50 per cent tin and 50 per cent lead used by the railroad in 1917 was approximately 100,000 pounds, but a large proportion of this consumption will be replaced by an alloy containing 60 per cent lead and 40 per cent tin.

The amount of new tin used in 1917 by the Pennsylvania lines east was approximately 770,000 pounds. The total amount of bearings alloys used was about 21,380,000 pounds.

For a number of years no tin has been used in the lining metal of either passenger or freight car journal bearings, except such as came from the remelting of old scrap.

Another eminently practical paper was presented by M. L. Lissberger, Mark Lissberger & Son, Inc., Long Island City, N. Y., on the subject of tin economy in solders. The method adopted by the speaker's company in making solders is first to melt the lead, then add a flux and skim the dross, after which the tin is added. After this addition, the bath of molten metal is stirred continuously for from five to six hours thoroughly to incorporate the metals. If this is not done, trouble from segregation will ensue, owing to the fact that tin and lead do not form alloys, but exist together as a mechanical mixture. It is necessary, therefore, thoroughly to break up the droplets of metal to enable those of the two metals to come into intimate contact and thus produce a more homogeneous mixture than is otherwise possible. This segregation is illustrated by the action which occurs when a block of solder 1 inch square and 6 inches high is cast. When the metals have been thoroughly mixed an analysis taken from the bottom will show 47 per cent tin and 53 per cent lead, and from the top 53 per cent tin and 47 per cent lead. This illustrates why so much more tin than lead is lost by drossing in making solders. The alloy from which the above example is taken is composed of 50 per cent tin and 50 per cent lead. For solders used as a filling metal and not as a cement, tin can be conserved by using an alloy of 20 per cent tin and 80 per cent lead. For adhesive purposes and especially for food containers, a solder containing around 40 per cent tin and 60 per cent lead is recommended.

In making solders, overheating must be avoided with the utmost care, otherwise, much tin will be lost on account of the excessive dross that will be formed, and as this dross is always richer in tin than in lead, the alloy itself is impoverished in tin, and much of this metal is wasted unnecessarily. An excellent solder consists of tin, 46 per cent, and lead, 54 per cent, with a small amount of antimony, about 0.25 per cent, which improves its appearance.

Other papers on the conservation of tin were presented by D. M. Buck, American Sheet & Tin Plate Co., Pittsburgh; W. M. Corse, Buffalo; and J. K. Burgess and Mr. Woodward, bureau of standards, Washington. A short talk was given by Jesse L. Jones. Mr. Jones stated that the Westinghouse Electric & Mfg. Co. has conserved tin by substituting lead-base for tin-base babbitts wherever possible, and by using a solder composed of lead 66 2/3 and tin 33 1/3 in place of a 50-50 mixture, for both pot and hand solders. Another saving has been instituted by making the tin-base babbitt linings thinner, in cases where they cannot be dispensed with.

A discussion developed on the feasibility of substituting cadmium for tin, but the more practical of those present regarded this as a dubious proposition. Professor Richards thought tin might be conserved by eliminating its use for all unnecessary purposes. He pointed out that the country's resources might be developed to advantage as deposits of ore were known to exist in this country which have never been developed. The symposium on the conservation of tin proved the most interesting of the sessions, and was the best attended.

A paper of a different type that proved of considerable interest was entitled "The Action of Reducing Gases on Copper", by Norman B. Pilling. This paper was of interest because it throws some light on the difficulties experienced in casting copper. It dealt largely with the effects produced upon copper by hydrogen at rather high temperatures, and in the discussion that ensued W. H. Bassett showed by means of lantern slides the effect that hydrogen has upon oxidized copper. The illustrations depicted samples of copper in the wrought condition that had been heated and then exposed to hydrogen. The result was that the cuprous oxide had been reduced to form water vapor, and as the oxide is found between the crystals of the metal, the action of the hydrogen had driven the crystals apart, producing ruptures in the copper.

Another paper of value was by G. F. Comstock, Titanium Alloy Mfg. Co., Niagara Falls, N. Y., on "Nonmetallic Inclusions in Bronzes and Brasses". This paper treated of the effects of the addition of tin oxide, zinc oxide, phosphides and silicates, and of the sand inclusions in copper and alloys which result when tin, zinc, phosphorus and silicon are added to oxidized copper. The paper showed how desirable it is at all times to use care in melting copper and its alloys in order to avoid oxidation, as if this is permitted it becomes impossible to obtain alloys that are of good mechanical properties.

Nonferrous Alloys Used by Pennsylvania Railroad

	Copper	Tin	Lead	Phos.	Antimony	Zinc
Phos. Bronze, special	79.70	10.00	9.50	0.80	.....	.....
Ex. B Bronze, special	76.75	8.00	15.00	0.25	.....	.....
Special High-Lead Bronze, special	70.00	5.00	25.00	.....	.....	.....
Lining Metal, special	.....	.....	87.00	.....	13.00	.....
Dandelion Metal	.....	10.00	72.00	.....	18.00	.....
Bell Metal	83-1/3	16-2/3	.....	.....	.....	.....
Babbitt, Tin-Base	3.70	88.90	.....	.....	7.40	.....
Babbitt for motor bearings	1.00	50.00	38.50	.....	10.50	.....

Iron and Steel Section Holds Double Session

FOLLOWING the joint opening session, the iron and steel section of the American Institute of Mining Engineers, met with the Institute of Metals division. On Wednesday a double session was held presided over by Prof. J. W. Richards, at which the papers scheduled for Tuesday and Wednesday were read and discussed.

Immediately preceding the meeting, motion pictures showing the triplex process of making steel were shown. The films were made at the South Chicago plant of the Illinois Steel Co. In the triplex process the metal is treated successively in bessemer converters, open-hearths and electric furnaces.

A paper by Henry M. Howe, chairman of the engineering division of the National Research Council, outlined the work of the council in investigating problems incident to the war. Aircraft, tanks, trucks, and control apparatus have received attention and in many cases investigations

which have been originated by the National Research Council have been taken over and continued by the war or navy departments. Welding as a substitute method for riveting in ship construction is under investigation at the present time.

"Notes on Certain Iron Ore Resources of the World," which was presented at the New York section meeting in May was read by title. Dr. Bradley Stoughton, secretary of the American Institute of Mining Enginers, directed attention to interest which Germany displayed previous to the war in securing data on ore resources and more particularly on coal resources. Prof. Richards stated that the published figures on available iron ore resources are misleading, in that they include only high grade ores, while the improvement of metallurgical processes constantly brings more ore into service. The fuel resources are alone the limiting factor on the future production of pig iron, he said.

H. R. Collins, Fuller Enginering Co., Allentown, Pa., read a paper on the use of pulverized coal. Mr. Collins mentioned the open-hearth plant of the Atlantic Steel Co., Atlanta, Ga., where temperatures of 3500 degrees Fahr. are obtainable with this fuel. He said in response to questions, that a grade of coal selling at $2 per ton may be burned in a furnace with greater economy than oil at 6 cents per gallon. Prof. Richards suggested that coal dried to 1 per cent moisture will absorb from 1 to 2 per cent from the air and that therefore the drying should not be carried to extreme in preparing pulverized fuel. In response to inquiries, Mr. Collins stated that approximately 22 per cent of ash passes off through the stack in burning pulverized coal. The particles are exceedingly fine and are carried to such heights that the nuisance common to smoke does not become apparent. Powdered coal, it was stated, is used successfully in some types of melting furnaces and no trouble is experienced due to ash floating on the metal.

A paper on "Carbocoal," prepared by C. T. Malcomson, Malcomson Briquet Engineering Co., Chicago, describes the briquet type of fuel. The suggestion is offered in this paper that experimentation might develop a combination of this form of fuel with pulverized coal with a view to saving the valuable by-products lost in the gaseous state when pulverized coal is burned alone. "Low Temperature Distillation of Illinois and Indiana Coals," was the title of a paper read by the author, G. W. Traer, Universal Coal Products Co., Chicago.

Conservation of Tin in Bronze Bearing Metals

By G H Clamer

TIN is of vital importance to many industries; but it is surprising how many and how excellent are its substitutes. Tin always has been a relatively high-priced metal, and it is natural to associate high prices with high standards. It is not until the price of a commodity becomes well-nigh prohibitive that substitutes are sought because the idea of substitution seems to involve an assumption that the substitute must necessarily be inferior.

The history of bearing bronzes is a striking example of this policy. In the early days, copper-tin alloys were almost universally used, the idea then being prevalent that a bearing to resist wear must be hard. The favorite bronze bearing contained 90 per cent copper and 10 per cent tin. Frequently, in service which was considered severe, even higher proportions of tin were used. Such hard alloys have great resistance to compression; but because of their inability to adjust their surfaces to slight irregularities in the journal, or to foreign bodies, they immediately begin to cut, and heating results. With a slight rise in temperature, the film of lubricant becomes thinner, and further cutting follows, if not actual adhesion between the bearing and the journal.

Lead Is Added

Many years ago, Dick, of England, appreciating the advantage of slight plasticity in a bearing, added some lead to the then standard bearing metal, reducing the copper, and produced an alloy, which has long held favor as a bearing metal The composition of this alloy is copper 80, tin 10, lead 10 per cent. This was the first step toward the production of plastic bronze alloys. Lead does not unite to form an alloy with copper, but remains mechanically mixed, so that structure of the alloy is that of a hard matrix with the soft metal imbedded therein.

It was not until several years later that tests were conducted on the Pennsylvania railroad, under the direction of Dr. C. B. Dudley, who investigated the copper-tin-lead series within certain limits of the 80-10-10 alloy. He studied not only the alloys containing lead above 10 per cent in which copper was replaced by lead, but also those in which tin was replaced by lead. His conclusions, which have since become firmly established, are that the rate of wear diminishes with increase of lead in the alloy; and the rate of wear diminishes with decrease of tin in the alloy. Fortunately, the alloy containing least tin and highest lead exhibits least tendency, in service, to give trouble from heating.

High Lead Alloys

Dr. Dudley's discoveries instigated research work, now 20 years ago, which led to the production of alloys still higher in lead and lower in tin than those which he was able to produce He experienced foundry difficulties which apparently limited the maximum lead alloy to 77 copper, 8 tin, and 15 lead. This was called Experiment B alloy, and has since been widely known as "Ex. B metal."

Recent practice has been able to produce alloys carrying 5 per cent of tin and as much as 30 per cent of lead which show no segregation of lead, even if cast into large bearings. That is, such bearings will show no indication of metallic lead upon any surfaces. Lead being mechanically held in the alloy, is prevented from segregating only by the quick setting of the matrix of copper and tin. As a certain interval must necessarily occur between the time when the metal enters the mold and the time when it solidifies, the lead always shows some tendency, owing to its high specific gravity, to liquate toward the bottom of the casting. In bearings made of the proper raw materials, and correctly handled, the difference in the proportion of lead at the top and at the bottom of a casting is not usually over a fraction of 1 per cent, or at most 2 or 3 per cent.

When these alloys were first produced they were backed only by laboratory tests and by the predictions of Dr. Dudley that all such alloys could be produced commercially. It is now possible to review 18 years' experience with the manufacture and service of such bearings. At times manufacturers overstepped the mark and placed such bearings in service where the loads or the impacts were too great.

Bearings Must Stand Impact

The first requisite of a bearing is that it shall be sufficiently hard to support its load or to resist the impacts to which it may be subjected, and the relation of tin to lead must be controlled by this requirement. Mistakes have been made in recommending the copper 65, tin 5, lead 30, alloy for certain mill bearings, which did not have sufficient resistance to compression, and failed for that reason. When the copper 73, tin 7, lead 20 alloy was substituted the bearings exhibited no deformation and performed far better than the 80-10-10 alloy previously used. The failure of the 73-7-20 alloy on rod bearings of heavy locomotives has been noted. Locomotive rod bearings are subjected to severe impacts and it is necessary therefore to use an alloy of fairly high compressive strength. Although the above alloy performs satisfactorily on light locomotives, on the rod bearings of heavy locomotives it is necessary to use either the 80-10-10 alloy or the same alloy to which has been added approximately 1 per cent of phosphorus. The size of these bearings, and hence their bearing surface, is narrowly limited by necessities of construction.

Phosphorus greatly increases the compressive strength of such an alloy, and is for this reason a possible fac-

Abstracted from a paper forming a part of a symposium on "the Conservation of Tin" presented at the Milwaukee convention of the Institute of Metals Division of the American Institute of Mining Engineers. The author, G. H. Clamer is first vice president and secretary of The Ajax Metal Co., Philadelphia.

tor in conserving tin. At the present prices of tin and phosphorus there is little choice, as an alloy with 8 per cent of tin and 1 per cent of phosphorus will have compressive strength approximately equivalent to the alloy having 10 per cent tin. Experience has demonstrated that alloys containing as little as 5 or even 4 per cent tin and as high as 30 per cent lead, can be used in railroad service for the heaviest duty. They have become the standard of the United States railroad administration for car-journal bearings called for under Specifications R-71, Grade A. Such an alloy also is included in the specifications covering locomotive bearings designated as Specification R-72, for soft bronze.

In my judgment the use of soft bronze should be extended to cover driving brasses, and engine and trailer-truck bearings. Before the railroads came under government control, copper alloys with low-tin and high lead contents had become the standard specifications of several of the large car companies, and were extensively used on the largest railroad systems. Outside of the railroad field they had also been widely recognized and used. The advantage of using the smallest possible amount of tin consistent with the lead requirements is now so well understood, that there is but little opportunity for an important conservation of tin in this field. Substituting some other metal for a part or all of the tin in a copper-tin-lead alloy, or of substituting alloys of an entirely different type constitute the only possibilities for a large saving in tin.

The first metal that presents itself as a substitute for tin is antimony. Antimony combines readily with copper and with lead, and has the property of adding hardness. Unfortunately, however, the hardening effect of antimony is obtained with the sacrifice of ductility. It is possible to make alloys carrying as high as 30 per cent of lead with 3 per cent of tin and 2 per cent of antimony. Alloys of 65 copper, 30 lead, 2 tin, and 3 antimony, have been made and in some cases the 5 per cent of tin in this alloy has been replaced entirely with antimony. Car bearings 4¼ x 8 inches in size made from the same pattern and subjected to a breaking stress applied longitudinally at the middle of the back of the bearing and throughout the entire length, broke at the following average loads: With 2 per cent antimony substitution, 60,000 pounds; with 3 per cent substitution, 62,000 pounds; with total substitution, 52,000 pounds. A breaking load of 67,000 pounds was sustained by the alloy of copper 65, tin 5, lead 30. The castings produced with each of the three above-mentioned alloys are not so satisfactory as those made with the straight tin alloys, being more or less rough, and showing slight globules of lead on the surface. It has been found that a certain amount of nickel can be used with satisfactory results for replacing tin. The castings produced when zinc is substituted for a certain amount of tin are decidedly unsatisfactory. The substitution of aluminum for tin is entirely impractical, and such castings are worthless. This does not, however, exhaust all the possibilities of substituting other metals for tin in the copper-tin-lead alloys, but it is my opinion that the substitution of any other metals, in those alloys, can be made only by sacrificing the quality of the alloy.

The possibility of substituting alloys of an entirely different type presents an attractive field for research. The copper-tin-lead alloy has attained its position as the most desirable bronze bearing alloy but this does not mean that some other alloy may not be found which may give equally good or better results. In the search for such a substitute alloy it should be borne in mind that a bearing metal should possess the following properties:

1.—It should be sufficiently rigid to support the load or resist the impact, but yet not so brittle that it will easily crack.

2.—It should have as great a yielding or plastic nature as is consistent with its ability to support the load or resist the impact without deformation of the bearing as a whole.

3.—The ideal structure combines a hard matrix to support the load and a softer metal or alloy contained within such matrix, to permit the bearing surface to adjust itself to irregularities of surface.

4.—It should be easy to handle in the foundry and machine shop.

5.—It should be capable of being remelted without deterioration.

6.—For use in babbitt-lined bearings, it should be capable of being tinned, so that the babbitt can be applied.

7.—It should have good heat conductivity in order to dissipate the heat generated by friction.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Melting Problems in Making Large Castings

We are figuring on making castings weighing about 6000 pounds, but have never had any experience with such large work. As our furnace capacity is only 2000 pounds, it will be necessary to put in a cupola, and we desire to know what size would be necessary, and if it would be possible to hold for two taps, or whether the metal should be melted at one time.

It is not possible to offer more than very general advice regarding how such a casting should be molded, because the shape and size of the casting will influence the method of molding and gating. It may be accepted, as a rule, that in the case of heavy castings, the sand must be much coarser than for small castings. It must also be much stronger, and if the mold is dried, some binder must be incorporated with the sand; otherwise, the mold would fall to dust. The venting is an important feature, as well as the method of gating, location and size of risers and the manner of pouring the casting. If the metal is melted in a cupola, it is not necessary to bring it all down at once as several taps can be made, but a thick cover of incandescent charcoal should be kept on the metal in the ladle. A small cupola is all that is required. If a cupola has to be installed for the job, it would be better to build an air furnace as the chances of getting sound castings would be much greater than with a cupola.

Reducing Sulphur in a Reverberatory Furnace

We have on hand some metal we would like to refine and any suggestions you may offer will be appreciated. The composition of the alloy is approximately, copper, 50 per cent; lead, 20 per cent; sulphur 2 per cent, and antimony, 6 per cent. We would like to know how to reduce the sulphur and antimony in a reverberatory furnace.

The sulphur can be oxidized, as both lead and copper oxide react with sulphur to form sulphur dioxide which will boil out of the metal. Copper and lead have about equal oxidizing qualities, therefore, copper and lead oxide will form and then react with the sulphur to form metallic lead and copper and sulphur dioxide. The sulphur ought to be easily eliminated. If the material is melted at a low heat in a reverberatory furnace, and the air allowed to play over it, the sulphur will be eliminated first, after which if there is any tin in the alloy, that and the antimony will next oxidize and can be skimmed off, after which the copper and the lead will oxidize. The metal remaining in the furnace will be oxidized and should be poled to remove the oxygen. Before attempting to refine the metal it would be advisable to melt experimental heats in a crucible furnace, adding copper and lead to bring the composition to 50 per cent copper and 50 per cent lead approximately. In so doing both the antimony and the sulphur would be reduced, and a satisfactory anti-friction metal produced. It would all depend upon just what metal the missing 22 per cent may be in this case.

Overcoming Aluminum Bronze Difficulties

We have experienced considerable trouble in making aluminum bronze castings. Our difficulty is caused by dross and shrinkage holes, also, we have not been able to obtain the physical properties required, which specify 65,000 pounds tensile with 20 per cent elongation. The alloy follows: Copper, 90 per cent aluminum, 8 per cent, and iron, 2 per cent. In making the alloy we first make a hardener by melting 8 pounds of copper to which we add 2 pounds of iron wire. Then we charge 8 pounds of aluminum and add a brass flux. This mixture is added to 82 pounds of copper. The castings are poured with a horn gate using a riser 3½ inches in diameter, 2 inches wide and 1¾ inches deep. Churning the riser seems to increase porosity at the intersection of casting and riser. We have used metal that was remelted several times, but the results have not been satisfactory. In pouring, the mold is fed through the sprue until the metal comes into the riser to a height of about 3 inches; then we stop pouring and on resuming fill up the riser through the sprue; when the riser shrinks we feed it again. The castings are cylindrical, 5 inches in diameter and 5 inches high, with a 1½-inch core through the center. The metal shows the proper composition on analysis, but something seems to occur during the melting process that should be eliminated to insure soundness in the castings produced.

To make sound castings of aluminum bronze on a commercial basis, that is, to keep the losses down to where the operation is profitable, it is necessary to approach the subject with an open mind, forgetting all that has been learned in making ordinary brass castings, with the exception of the proper way to ram the mold. Experience with manganese bronze is of some assistance, but as far as ease of casting is concerned there is a great difference between the two alloys, and that difference greatly favors manganese bronze.

The subject of casting aluminum bronze is so extensive that a volume would not exhaust it, therefore, it can only be touched upon here. With regard to the mold, the sand should be free venting and is used rather dry. The ramming is the same as for any other metal or alloy. The gating is different. The gate must always be located at the lowest point of the casting and the aperture through which the metal flows must be small and shaped so that the metal will not be sprayed into the mold; neither must it enter with a jet effect. The more easily and gently the metal enters, the freer from dross will be the casting. The art of cutting and locating gates for aluminum bronze is a science, and can never be given too much study. The riser is distinguished by its relatively large size. The one mentioned is much too small for this metal, and to make the casting in green sand without chilling will require as much metal in the riser as there is in the casting.

In making cores, never use oil or rosin sands for aluminum bronze, and in melting metal never use any flux that is used on ordinary brass or bronze; use nothing except charcoal, and possibly a little manganese chloride. Use tin plate for the iron supply when this can be obtained, but there is no objection to thin core wire, provided it is free from oxides. To make the alloy, melt the copper, under charcoal and when thoroughly liquid, add the aluminum in the solid form, in small pieces, and stir between each addition. Stir and pump the metal thoroughly after the aluminum is in, and run into ingots. Remelt the ingots under charcoal for the castings. A little manganese copper, about 1 per cent, can be added to advantage, but keep all other fluxes away; use clean crucibles, electrolytic copper to insure freedom from arsenic and other impurities, and good, commercially pure aluminum. When iron is put into the alloy, add the iron before the aluminum. To get 65,000 pounds tensile strength with the alloy named is not consistently possible, but it ought to possess around 40 per cent elongation. To get 65,000 tensile, it will be necessary to increase the iron materially, or to increase the aluminum to 9 per cent. The holes in the castings can only be eliminated by careful attention to the points here outlined.

A Cheap Bearing Mixture Equivalent to Malleable Iron

We would like to obtain a cheap mixture of tin, lead, antimony, brass and other metals that have good wearing qualities, and are capable of being alloyed to make a metal that will equal malleable iron. This alloy must melt at a low temperature, should be fluid for running thin castings and should have about the same strength and malleability as malleable iron.

A typical tin, lead and antimony alloy follows: Lead, 80 per cent; antimony, 15 per cent, and tin, 5 per cent. To make this mixture melt a part of the lead, dissolve the antimony therein, cool to a silvery color with the balance of the lead and then add the tin. This makes a good antifriction alloy suitable for lining bearings and it may also be used for making white metal patterns, but it will not take the place of malleable iron for any kind of service. It is presented here as an illustration of the kind of alloys it is possible to make with such metals as tin, lead and antimony. Brass could not be alloyed with such a mixture, nor could zinc. A small amount of antimony will ruin any kind of brass, therefore, it must be carefully kept away from such alloys. The cheapest brass alloys are usually those containing a high percentage of zinc with a little aluminum to make them easy to cast and sometimes a little lead to make them easy to machine. The following alloy is the best you can do in this line, unless you have access to some very cheap yellow brass scrap: Copper, 54 pounds, 11 ounces; zinc, 40 pounds; lead, 5 pounds, and aluminum 5 ounces. Add the aluminum to the copper as soon as it is melted, then the zinc and next the lead. This sequence is necessary to attain the desired properties.

Overcoming the Segregation of Lead

We are making centrifugal pump impellers, weighing about 155 pounds, from an alloy composed of copper, 86 per cent; lead, 12 per cent, and tin, 2 per cent. We first melt the copper under charcoal, then add the lead, stirring thoroughly and follow with one pound of tin and one pound of phosphor-tin. We use a flux composed of 4 ounces of borax, 2 ounces of soda ash, 8 ounces of sharp sand and 2 ounces of roll sulphur. This is added after the metal is skimmed. The molds are made in dry sand, and we find that the lead settles to the bottom of the castings.

We suggest a change in the mixture as the one being used is too weak to give satisfaction for such castings as impellers. The following alloy will be an improvement: Copper, 85 per cent; tin, 5 per cent, and lead, 15 per cent. Melt the copper under charcoal, add borax and salt and when molten, charge the tin and follow with the lead; stir thoroughly and pour at a medium temperature. Do not use the flux that you are now employing on phosphorous. If it is necessary to make the alloy with 2 per cent tin and 12 per cent lead, omit the phosphor-tin and instead, use ordinary tin. Also omit the flux, but if the lead still drops, change the flux by omitting the sulphur and sand and replace them with 16 ounces of plaster of paris. Add one-half the flux with the copper and the remainder after the lead has been stirred-in and proceed as outlined in the inquiry.

Making a Manganese Bronze Mixture

We would like to obtain a mixture for manganese bronze. We are making castings weighing from 50 to 800 pounds each, from a mixture of copper, 88 per cent; tin, 10 per cent, and zinc, 2 per cent. We are of the opinion that manganese bronze could be substituted for this alloy and would be cheaper to make.

The usual method of making manganese bronze is as follows: A steel alloy is first made as follows: Melt 18 pounds of wrought iron with 4 pounds of ferromanganese, and when thoroughly liquid and well mixed add 10 pounds of tin. Pour into thin bars that can be easily broken to make small weights. To make the bronze, melt 56 pounds of copper and 2.5 pounds of the steel alloy; when the latter is thoroughly incorporated add ½ pound of aluminum and 41½ pounds of zinc. Stir well and pour into ingots. Remelt the ingots for the castings and if the alloy has been properly mixed a strong ductile metal will result; however, if not properly made, a weak and brittle alloy will result.

An easier way of making manganese bronze is to melt together 44 pounds of lake copper and 12 pounds of 30 per cent manganese copper, and when liquid add 2 pounds of aluminum. Allow the metal to cool somewhat and then add 42 pounds of zinc, stir well, ingot and remelt the ingots for the castings.

Making Ordnance Steel for the Army and Navy

Problems of Steel Castings Manufacturers in Meeting Government Specifications Are Discussed—Three Essential Elements of Proper Practice Are Presented

By John Howe Hall

THE tests which have to be met on army and navy steels are shown in the accompanying tables. For the purposes of comparison, I have shown the specifications of the army and navy, the American Society for Testing Materials and Lloyd's Register for similar steels in groups. The last group in this list requires no comment except that certain castings on the army blue prints are marked simply "cast steel" and this has been interpreted to mean a good grade of material such as would be supplied for commercial work and no specifications either chemical or physical have been called for on it.

It will be seen on looking over the chemical specifications in the first two columns of the table that in spite of the earnest efforts that have been made by the committee of the Steel Foundry society, it is not yet possible in a great many cases to use one and the same steel for both army and navy work.

Various Processes May Be Used

The army has consented to raise its limits on phosphorus to 0.06 per cent and on sulphur to 0.08 per cent for No. 1 and No. 2 steel and the same limits are allowed for No. 3 steel, provided the carbon is not over 0.35 per cent. If the carbon is over 0.35 per cent, phosphorus must be below 0.05 per cent and sulphur 0.07 per cent. This makes it possible to turn out Army No. 1 and No. 2 steel from either acid open-hearth, acid electric, basic open-hearth or in many cases from the tropenas converter without undue difficulty with fuel and raw material. The army No. 3 steel with phosphorus at 0.05 per cent and sulphur at 0.07 per cent cannot be met in the tropenas converter by most makers because the specification of the army forbidding the rapid cooling of castings after annealing makes it impossible to meet the physical tests with carbon below 0.35 per cent. This steel, therefore, is usually made in either the open-hearth of the electric furnace.

The specifications of the navy as written call for such low phosphorus and especially sulphur that the tropenas foundries and in some cases the acid open-hearth foundries will find it impossible to meet the chemical specifications under existing conditions. It is the understanding of the writer, however, that the navy has waived the chemical specifications within reasonable limits on certain classes of castings on which they could be assured that the manufacturer turned out a high grade of steel in other respects and that he was capable of meeting the physical specifications of the steel in a satisfactory manner.

Turning to the physical specifications, there should be no great difficulty in meeting the tests for Army No. 1 steel and for Navy B steel with properly made castings of about 0.25 per cent carbon and from 0.60 to 0.80 per cent manganese. These tests should be met by any good cast steel of this composition annealed in the usual way by heating several hours at about 1650 degrees Fahr. and cooling slowly in the furnace. The Lloyd's Register specifications for ship and engine castings are apparently intended to suit a steel of about the composition just given, although the bending test which they specify on a ¾-inch thick bar is considerably more difficult to meet than that of the army and navy or the American Society for Testing Materials. The fact that Lloyd's also calls for a maximum as well as a minimum in tensile strength might prove embarrassing in some cases, but the writer understands that Lloyd's and the American bureau of shipping, whose specifications are closely parallel to Lloyd's, are not standing rigidly on the maximum specifications for tensile strength, provided the steel has sufficient toughness as exhibited by the extension and bend.

The writer has not had experience with recent tests made under Lloyd's Register, so that he is not able as yet to form any judgment as to the severity of the drop tests and hammer tests specified by Lloyd's bureau. The hammer test, which consists in slinging the castings in the air and hammering them all over with a 7-pound sledge does not sound to him very formidable, as it must be a very poor casting indeed that would develop any cracks or flaws under this test, especially if the annealing has been properly carried out. The drop test, which calls for dropping either one end of the casting or the whole casting on the hard ground, would seem at first sight to present no difficulties to the foundryman except the inconvenience of carrying out the test and the possibility of bending the castings out of shape. No doubt members who have had experience with these tests can contribute interesting opinions as to the value and difficulty of the test.

Medium Steel Specifications

The physical specifications for medium steels, including Army No. 2 and Navy D, should be met with steel of about 0.35 per cent carbon and from 0.60 to 0.80 per cent manganese, but more trouble will be met with in the case of the navy steel as it calls for very considerably more strength and elastic limit than the soft steels and at the same time calls for the same extension, contraction and bend as that specified for Navy B. In the majority of cases the writer would recommend the use of a double annealing, such as will be described later, for Army No. 2 and especially for Navy D.

The hard steels, Army No. 3 and Navy A, are usually made of about 0.45 per cent carbon and from 0.60 to 0.80 per cent manganese, and steel of this composition properly annealed should meet the specifications in a majority of cases. For this class of steel the double treatment is even more to be recommended than for the medium steels.

The two specifications for special steels are apparently intended to be filled with nickel steel. The writer has had no experience in the manufacture of castings to meet these tests and is not prepared to state what difficulties would be encountered in executing orders to meet these specifications, although he has information of one foundry which is making steel from the acid open-hearth furnace to meet Navy F specifications. This foundry is using steel of about 0.25 per cent carbon and 3 per cent nickel and is using a double treatment somewhat similar to that described further on, with the exception that the second heating is at a considerably higher temperature than that advocated by the writer.

How To Meet Navy F Specifications

In all fairness the writer feels he should say that if he is called upon to make steel for Navy F specifications he will use a special composition of steel with rather high manganese in proportion to the carbon, and will try to be allowed to heat-treat these castings by quenching in water or oil and reheating. This method of heat treatment is prohibited in the specifications but as the writer has had long experience in carrying it out he believes that it would be possible to persuade authorities to allow him to use it, and that he would be able to meet the specifications on all castings where oil quenching is possible. On castings too heavy or too complicated to permit of oil quenching he confesses he would be somewhat at a loss to know just how to meet these specifications with certainty, and hopes that the discussion of this paper will shed some light on this point.

It is difficult to overemphasize the importance of three principal factors, the neglect of which will cause the foundryman trouble in meeting these specifications. The first is that the steel must be properly made and thoroughly deoxidized, so that it will be quiet in the ladle and set sound in the castings and test bars. The steel must be made carefully, and usually the tonnage turned out is reduced on account of the slower and more care-

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ful furnace practice that must be followed. The second is that as much care, or even more care, must be taken in molding and pouring test bars as is taken with the castings. It seems a strange freak of human nature, yet foundries which are not familiar with specification work will in a great many cases be extremely careless with the designing, molding and pouring of the test pieces, in spite of the fact that the tests are not easy to meet, and are to be met not on the castings themselves but on the test bars. A little experience with heats lost because good test bars could not be turned up from the test coupons provided usually awakens the foundryman to the necessity of taking great pains with his test bars and coupons.

A number of designs of test coupon are used in different foundries, but the principle in all of them is to make sure that there is sufficient metal provided in some form of sink head or enlargement of the upper part of the coupon to make the lower portion perfectly sound and free from blow holes. The test bar or bars are generally cut, of course, from the lower part of the test coupon.

Care In Heat Treatment Demanded

The third point which has to be very carefully watched in the manufacture of these specification steels is the annealing or heat treatment.

The writer had a recent experience with a good friend in the foundry business who used a somewhat unusual chemical composition for Army No. 3 cast steel at the writer's suggestion. He did not for some time have very good luck with the tests, stating that the steel was "wonderful when it was good and rotten when it was bad." The writer at this time was very busily engaged in finding out why a few heats of steel which he had made could not be induced to pass these specifications and did not have time to pay a visit to his friend who was struggling with Army No. 3. After a month or two he saw the friend, who informed him that he had traced practically his entire difficulties to the heat treatment, and that he was then passing Army No. 2 and No. 3 specifications practically without rejections.

Whatever annealing and heat treatment practice is followed, it is absolutely essential to make sure that the castings are subjected to the proper degree of temperature for a proper length of time. To do this it is not sufficient simply to have a pyrometer in the furnace to read the temperature desired, because the pyrometer may not be indicating the temperature of the entire furnace, and for that matter the castings in the furnace may not have all reached the required temperature at the same time that the pyrometer did. The writer would hate to try to pass army and navy specifications with an annealing furnace so constructed as to make it impossible to look at the castings and judge their temperature by eye. If the castings are easily seen through a peep hole, it is possible to make sure that the color of the castings is the same as the color of the place in the furnace where the pyrometer is located and so avoid improper heating of the castings.

For what might be called old fashioned annealing of the average casting of average size, the writer believes that the steel should be heated to about 1650 degrees Fahr. for a period of at least two hours, and better for four hours. It is definitely known that a certain length of time is required for proper annealing after the castings are actually hot through at the desired temperature. For castings of average size it is not necessarily true that the annealing requires as much as four hours after the castings are hot, but from an experience of some years the writer has come to the conclusion that it is better to use too long than too short a time, especially as too short a time may mean that some of the castings do not even reach the desired temperature.

After the four hours heating at 1650 degrees Fahr. the castings may be cooled slowly in the annealing furnace, and if the chemical composition has been correct, this treatment should give the steel a sufficiently good anneal to pass any of the specifications that have been discussed in the foregoing. The writer, however, very much prefers to use a double treatment which consists in cooling the castings as rapidly as possible in air and afterward reheating them to a temperature of between 1200 and 1300 degrees Fahr., the exact temperature depending on the carbon and manganese of the castings. This second heating at a low temperature must in most cases be continued for a considerable length of time. The writer uses up to six hours at these temperatures in cases where the carbon and manganese are somewhat high, so that the principal thing to look out for is the extension and contraction rather than the strength. It might seem possible with this double treatment to use a somewhat higher temperature for the second heating and hold the castings at that temperature for a shorter period. It has been found, however, that for the best results, the temperature on this second heating should not exceed 1300 degrees Fahr. because to exceed that temperature does more harm than good. The writer has published data on this point at various times and the only object of referring to it here again is because he has run across several cases lately where two heatings are used and the second heating is so high that apparently better results would be secured by heating only once and cooling slowly in the furnace.

In the majority of cases where this double annealing is practiced it is better to cool in the furnace after the second heating, but this is not essential, since only very slight strains are set up in the castings if they are cooled in air from 1300 degrees Fahr., and the air cooling from this temperature does not affect the test bars enough to show up in the tensile test.

One of the most vexatious features in the production of castings to meet these specifications is the great number of tests that have to be made on each heat of steel. The army calls for one tensile test from a coupon cast attached to each casting over 200 pounds in weight, and the same number of tests from a separate coupon for each heat of castings weighing under 200 pounds. Under the stress

Comparison of Specifications

SOFT STEELS

	Phosphorus	Sulphur	Tensile strength	Elastic limit	Elongation in 2 inches per cent	Contraction of area per cent	Bend test degrees
Army No. 1	0.06	0.08	60,000	27,000	22	30	...
Navy B	0.06	0.05	60,000	27,000	22	30	120
ASTM "Soft"	0.06*	0.06	60,000	27,000	22	30	120
Lloyd's Ship	....	....	58,240 to 78,400	.....	20	..	120†

Remarks:—"Drop" and Hammering tests also specified.

MEDIUM STEELS

Army No. 2	0.06	0.08	70,000	31,500	18	25	...
Navy D	0.05	0.05	70,000	31,500	22	30	120
ASTM "Medium"	0.06*	0.06	70,000	31,500	18	25	90

HARD STEELS

Army No. 3	0.05	0.07‡	80,000	36,000	15	20	...
Navy A	0.05	0.05	80,000	36,000	17	20	90
ASTM "Hard"	0.06*	0.06	80,000	36,000	15	20	...

SPECIAL STEELS

Army "Special"	0.05	0.07	90,000	55,000	15	25	...
Navy "Alloy F"	0.05	0.05	85,000	53,000	22	35	120

STEELS WITHOUT TESTS

	Carbon	Phosphorus	Sulphur
Army cast steel	...	...	...
Navy C	...	0.06	0.07
ASTM Class A	0.30 Max.	0.06	...

*For basic Steels, Phosphorus to be 0.05 per cent.

†Bend to be 1 x ¾-inch, corners rounded to 1/16-inch radius, bent to a radius of 1 inch.

‡For army No. 3 steel, if carbon is below 0.35 per cent, phosphorus may be 0.06 per cent and sulphur 0.08 per cent.

of war conditions this specification is not adhered to rigidly, and in fact it is almost essential that it be modified in cases where a great many castings are made on one heat which would usually call for a test on each casting under the strict letter of the specifications as they are now understood and interpreted.

The navy calls for one tensile and one bending test from a coupon attached to each casting over 200 pounds and for two tensile and one bending test from a separate coupon for each heat of castings weighing under 200 pounds. In some cases the inspectors have demanded tests from two or three castings weighing over 200 pounds on a heat and have insisted that the two tensile tests from a separate coupon to cover the light castings on the heat should be taken from different coupons. When this specification is rigidly adhered to, the number of tests demanded from a shop making heavy heats of medium weight castings is so great that the job of taking care of the tests becomes a very onerous one. Having had experience with only a few orders of navy castings the writer is not aware just what modification may have been made in this specification in other shops.

For comparison with the requirements just enumerated it may be stated that the American Society for Testing Materials calls for one test from each annealing furnace charge of castings, except when several casts of steel are represented in the annealing furnace charge. In this case one test is required for each cast in the annealing furnace. Castings under 500 pounds, or castings of such design as to make it difficult to attach a coupon, may be represented by a coupon or coupons cast separate, in which case one test is required for each cast of steel. In order still further to simplify the testing of small castings a clause is inserted allowing the testing of small or unimportant castings by breaking up three or more castings from the heat, those castings to exhibit a proper degree of toughness and freedom from defects in each case.

Lloyd's bureau of shipping requires one tensile and one bending test from a coupon attached to each casting and the specifications state that for larger castings two tensile and two bending tests will be required, and that if more than one melt of steel goes into the casting four tensile and four bending tests will be demanded. Not having executed any orders for them yet the writer is not aware how rigidly the inspectors are instructed to stand on this specification.

Sale and Distribution of Foundry Pig Iron

(*Concluded from page* 529)

They proclaim the urgent necessity for the foundry plants of this country to readjust themselves so that they shall effect every possible economy in the use of iron and to concentrate their attention only upon such work as clearly shall be of an indispensable character. If they do not, no one would care to predict the consequences. The suggestion from Washington on this point is direct and unmistakable.

Even were this not the case, the tremendous demands for steel from the government and its allies and from the esesntial nonwar requirements of the country would be deeply significant. At present these orders, the steel director estimates, aggregate at least 23,000,000 tons, representing a practically eight months' production and they are still growing. To fill them every steel works in the country must be driven at top speed for an indefinite period. This means the providing of constantly maximum supply of all elements of production, at the base of which is pig iron. Modern war largely is in terms of steel. It conscripts blast furnaces as readily as it does human lives.

In the words of Judge Edwin B. Parker, chairman of the priorities division of the government, steel is the most precious metal in the world today. With equal truth he could have said the same of pig iron, for without it no steel is possible. It becomes, therefore, the highest patriotic duty of every foundryman in this country to make every ton of pig iron count for its full value. Waste today is more than an economic, it is a national loss. Every foundry proprietor, manager or superintendent should keep before him daily the fact that for each ton of pig iron wasted, 3300 hand grenades are lost to the boys in the trenches.

Foundry Iron Production Declines

During the first half of this year the production of foundry pig iron in the United States declined more than 200,000 tons below the output of the second half of last year and was nearly 100,000 tons less than the production during the corresponding six months of 1917. With further restrictions on foundry iron manufacture it is certain that the last half of this year will show a further decline and it is probable that during 1918 foundry pig iron production will be less than it has been for many years. According to statistics compiled by the American Iron and Steel institute, the production to June 30 was 2,518,721 tons compared with 2,725,810 tons the last half of last year and 2,602,448 tons the first half of 1917. On the other hand, malleable pig iron showed an increase of 20 per cent in tonnage over both six month periods of 1917. During the first six months of this year 607,318 tons of malleable pig iron was made against 505,597 tons the last half of last year and 509,982 tons the first half of last year. Charcoal pig iron showed a marked decline with an output of only 173,394 tons as compared with 196,290 tons the last six months of 1917, and 180,235 tons the first six months of last year. Michigan continues to be the largest charcoal pig iron producing state with a tonnage of 124,209 to June 30.

The total pig iron production was 18,227,730 tons as compared with 19,362,981 tons the first half of last year and 19,258,235 tons the corresponding period of 1917. It is doubtful whether the loss of more than 1,000,000 tons can be gained during the last six months.

Book Review

Scrap Metals, by George H. Manlove, Chicago, editorial representative of the Penton publications; and *The Old Metals*, by Charles Vickers, Buffalo, metallurgical editor of THE FOUNDRY; cloth; 278 pp., 5 x 7½ inches; published by The Penton Publishing Co., Cleveland; $2 postpaid.

These two books bound into one furnish the first literature ever published in complete book form on the iron and steel scrap and old metals trades. Mr. Manlove has had exceptional opportunities in reporting the iron and steel markets in Chicago and elsewhere for *The Iron Trade Review* and *Daily Iron Trade and Metal Market Report*, and much unique and valuable information thus obtained by him has been incorporated in these pages. Not only does the writer present a comprehensive and analytical survey of the scrap markets, but he also sets forth much information, a great deal of it new and unpublished up to this time, concerning the collection, preparation and selection of all the various grades of iron and steel scrap. Accompanying these valuable descriptions of the uses of the various kinds of scrap is a series of scrap definitions as laid down by the American Foundrymen's association, the Railway Storekeepers' association and the actual mill specifications as defined by specified representative purchasers and consumers. Mr. Manlove's style of composition is at once entertaining and clear. This book ought to be in the hands of every buyer, seller and consumer of iron and steel scrap.

Mr. Vickers has set forth in the section devoted to the old metals a vast amount of information as to the grading and uses of the different scrap metals, telling of their composition and preparation. Valuable hints to users of metals also are contained in it, all written in a lucid style.

Core Sand Mixtures

By Charles Vickers

In making cores to be used in castings containing aluminum such as manganese-bronze and aluminum-bronze, no oil should be used, otherwise the castings will be discolored.

The mixture given below makes a good core that will not produce discolored castings. Also it is very convenient in foundries where the drying facilities are not of the best. The formula follows: Take starch, 4 ounces; powdered glue, ½ ounce; and water 1 pint. Add the starch and the glue to the water. Allow the starch to soften, then stir. Heat the mixture until the starch becomes thick and jelly-like. Stir constantly to prevent the mixture burning to the bottom of the vessel, or heat in a double kettle. When the starch has jellied, add dry core sand to the mixture until it tempers to a working consistency. This will be about 15 pounds of sand. Thoroughly mix the sand and the jelly, rubbing them together, and wipe out the core boxes with a piece of waste saturated with kerosene to prevent the sand sticking. After the cores are made, spray with water and dry at a gentle heat.

Government Requirements For Steel Castings

Physical Properties Asked by the Ordnance Department for the Three Principal Grades of Steel Castings Are Discussed in Detail

By Capt. E R Swanson, U. S. A.

REQUIREMENTS as to physical properties for the three principal grades of steel castings for the ordnance department are now the same as those of the American Society for Testing Materials. The chemical properties also are identical with the American Society for Testing Materials specifications, except that greater latitude is given in the case of sulphur. For reference the figures are given as follows:

Cast steel	Elastic limit per sq. inch	Tensile strength per sq. inch	Elongation per cent in 2 inches	Reduction of area per cent
No. 1....	27,000	60,000	22	30
No. 2....	31,500	70,000	18	25
No. 3....	36,000	80,000	15	20

The time at the writer's disposal does not permit the extended detailed observation for presentation that the subject merits, and in fairness to the foundrymen, much matter available could not be published and accredited.

Practically all steel castings for ordnance purposes are made by the acid open-hearth, electric furnace or side-blow converter.

Two Methods Pursued

The problem of meeting requirements has resulted in the establishment of two methods. One makes use of combinations of low carbon and high manganese; the other, high carbon and normal manganese. The first method is of especial value to the converter shop.

The chemical analysis followed by a shop getting 98 to 100 per cent acceptances on first test for the No. 2 steel, using the converter, is as follows: Carbon, 0.26 to 0.30 per cent; manganese, 0.65 to 0.75 per cent; silicon, 0.26 to 0.35 per cent; sulphur, 0.07 per cent, and phosphorus, 0.05 per cent.

This steel is annealed by heating to 1650 degrees Fahr., soaking four hours at that temperature and cooling slowly in the furnace. This shop is not making any of the No. 3 grade steel.

One shop is working on orders various items of which call for No. 1, No. 2 and No. 3 grades. Their practice is to fill them all with steel of the No. 3 grade, using the converter process. Their chemical analysis is as follows: Carbon, 0.38 to 0.45 per cent; manganese, 0.75 to 0.85 per cent; silicon, 0.40 to 0.50 per cent; sulphur, 0.04 per cent, and phosphorus, 0.05 per cent.

This steel is annealed by heating to 1575 degrees Fahr., soaking four hours at that temperature and cooling slowly to 700 degrees Fahr., in furnace, at which temperature castings are pulled out into the air. This practice results in 95 per cent acceptances on first test.

Another company using converters for the No. 3 grade, works to the following analysis: Carbon, 0.25 to 0.30 per cent; manganese, 0.90 to 1.00 per cent; silicon, 0.30 to 0.35 per cent; sulphur, 0.07 per cent; and phosphorus, 0.05 per cent.

This steel is annealed by heating to 1700 degrees Fahr., soaking four to six hours at that temperature and cooling in air. It is then drawn by heating to a temperature of 900 to 1100 degrees Fahr., depending on the carbon, and cooling slowly in furnace. This firm deals with the No. 2 grade steel in much the same manner except that the carbon in this case ranges between 0.24 and 0.28 per cent, with manganese between 0.85 and 0.90 per cent. The castings are annealed at 1750 degrees Fahr., with subsequent draw.

A most successful company using the electric furnace for the No. 3 grade, works to a chemical analysis as follows: Carbon, 0.25 to 0.30 per cent; manganese, 1.10 to 1.30 per cent; silicon, 0.35 to 0.45 per cent; sulphur, 0.05 per cent, and phosphorus, 0.04 per cent.

Castings are annealed by heating to 1650 degrees Fahr., and soaking three to four hours at that temperature, cooling in the air, and then drawing at from 900 to 1100 degrees Fahr., cooling slowly in furnace.

Electric Furnace Analysis

Another company successfully meets the requirements for both No. 2 and No. 3 grades of steel by making only one grade, namely, the No. 3, using the electric furnace. Their average analysis is as follows: Carbon, 0.38 to 0.42 per cent; manganese, 0.60 to 0.70 per cent; silicon, 0.25 to 0.35 per cent; sulphur, 0.05 per cent; and phosphorus, 0.04 per cent.

They anneal this steel by heating to 1650 degrees Fahr., soaking at that temperature for six hours, and cooling the castings slowly in the furnace four to six hours.

The chemical analysis followed by a company using the acid open-hearth which has had 100 per cent acceptance is as follows: Carbon, 0.42 to 0.48 per cent; manganese, 0.65 to 0.70 per cent; silicon, 0.25 to 0.30 per cent; sulphur, 0.04 per cent, and phosphorus, 0.05 per cent.

Their practice is to allow three hours heating, two hours soaking at 1650 degrees Fahr., and five to eight hours cooling in furnace.

A resume of the foregoing shows the manner in which requirements are being met by companies having from 95 to 100 per cent acceptances on the first test. The high percentage of acceptances show that specifications are not excessive.

A very elaborate treatise could be drawn up on the subject of critical temperatures, length of annealing periods, etc. The critical point will vary according to the chemical analysis. You all know that to secure proper refinement of structure all parts of castings must be heated above the critical point and held long enough to permit necessary refinement. This period will vary according to the thickness of section.

Specifications Can Be Met

Disclaiming any desire to criticise equipment or methods in shops having difficulties, it is desired to make this point—that No. 2 and No. 3 grades are being made successfully and commercially. In order to do this, two things are required: *First*, control of analysis of product, so that the castings will analyze within predetermined limits; and *second*, annealing equipment of such nature that the furnace can be brought up to the desired temperature at a predetermined rate with equal temperatures prevailing in all parts of furnaces at the same time.

Control of analysis is had by competent supervision assisted by suitable chemical laboratory equipment.

Control of heat treatment can be exercised by the use of properly designed furnaces, so constructed that uniform heating prevails together with proper circulation; and the installation of proper recording pyrometers equipped with sufficient thermocouples so that furnaces can be checked for cold spots.

The absolute fundamental in meeting the requirements of the No. 2 and No. 3 grades is proper chemical analysis, supplemented by accurate annealing or heat treatment.

An extreme illustration of what has been done in the past, in a shop not equipped to anneal small castings, follows: The practice was to wait until a heat was poured which left a heavy skull in the ladle. The castings were annealed (?) by throwing them in the ladle and leaving them until the skull was cold. It is to be expected that they would experience trouble.

Most of the wideawake steel foundries have by this time discovered their weaknesses and have remedied them by installation of suitable up-to-date equipment.

Occasionally a heat is discovered that does not respond to proper heat treatment even though analysis is normal. An examination with the microscope will usually show the difficulty. Many companies are using the microscope as a daily check on their product. This is a refinement of practice that up to a short time ago prevailed in but very few foundries.

Presented at the twenty-third annual convention of the American Foundrymen's Association, Milwaukee, Oct. 7-11. The author, Capt. E. R. Swanson, is associated with the inspection division, ordnance department, U. S. A., Washington.

How to Select Suitable Sand-Blast Equipment

Results and Operation Costs Should Carry Greater Weight Than First Price—The Various Types of Apparatus Are Fully Described

By H D Gates

THE history of the last decade or two has recorded no more striking example of ability to stand up under adverse conditions than that displayed by the foundry industry. No surprise, therefore, is occasioned by the industry's whole-hearted response to the nation's cry for manpower, threatening, as it does, its very existence. As this demand becomes more insistent in the future the use of every dependable device that will release labor becomes a patriotic duty. Fortunately some devices make this duty a profitable venture and none more so than an efficient sand-blast.

Any discussion of sand-blast equipment must recognize that probably no other class of men are as familiar with its operation as the foundrymen, for it was in the foundry that the sand-blast found its first broad and general application.

It is said that familiarity breeds contempt and it may be on this premise that the foundryman approaches the selection of sand-blast equipment with less assurance of attaining desired results than men in other lines of business. The economy and advantages to foundry operation resulting from an efficient, well planned system are so firmly established that no reiteration of them is necessary. Any doubt of this is refuted by the constantly increasing number of sand-blast installations—installations too that run into tens of thousands of dollars where a decade ago a thousand dollars seemed a big sum to spend for this equipment.

From a paper presented at the 1918 meeting of the American Foundrymen's association. The author, H. D. Gates, is sales manager, Pangborn Corporation, Hagerstown, Md.

Interest today is in either the selection of satisfactory new equipment or the economical operation of apparatus already installed, and an analysis of the factors bearing on this problem should prove of value. Failure to accomplish either or both of these results may nine times out of ten be charged to the foundryman himself, but this is rarely acknowledged, and without investigation or reason, inability to secure results is at once charged to the sand-blast equipment. This is bound to continue until the purchaser approaches the subject with a different attitude than at present.

Fundamental Considerations

In considerations of this subject shape the investigations first to an intelligent understanding of what an efficiently planned system will accomplish and save. Forget the purchase price until the requirements have been fully determined and met by a system laid out and designed to secure the minimum cost of cleaning. Unless this result is attained the installation will be an expense instead of an investment. Let the purchase price be the last consideration, for with other factors clearly defined, it is easy to determine whether the results to be obtained warrant the expenditure proposed.

Remember too that purchase price is a one-time expenditure—operating cost is continual, and a small saving per ton in cleaning cost will soon return the cost of the equipment. It represents just the difference between a gain and a loss.

Every foundry has conditions and operations peculiar to itself. Each installation should be an entirely individual problem—but it is far from such when the foundryman writes for "catalog, prices and delivery" on sand-blast equipment. Results are the final test of the *cost* of a sand-blast system and they are attained only by utilizing experienced counsel trained in sand-blast engineering and practice, and by no means less important, whole-hearted co-operation from the foundryman's own organization.

A recent incident in this connection will illustrate the lack of appreciation of the need for complete information. One of the largest industries in its line in the United States producing war material sent out over the signature of its purchasing agent a so-called specification for a sand-blast installation asking "prices and delivery by return mail." The specification as written showed such lack of adaptability to stated requirements that an engineer was immediately sent to ascertain existing conditions. Let us quote the engineer's report:

"I shall never forget Mr. Purchasing Agent. We seriously wounded his pride by hinting that his letter was not entirely sufficient to give an intelligent bid on his requirements. His response to my introduction was, 'We are extremely busy here and perhaps your time is also limited—you have wasted valuable time calling here that could have been used preparing data that would have been of service to us. Good bye!'"

A proposal was made on this so-called specification; it figured in the neighborhood of $20,000. Later another department asked an engineer to call and go over the plans. A four-hour conference developed conditions that entirely eliminated the original specification and the substitu-

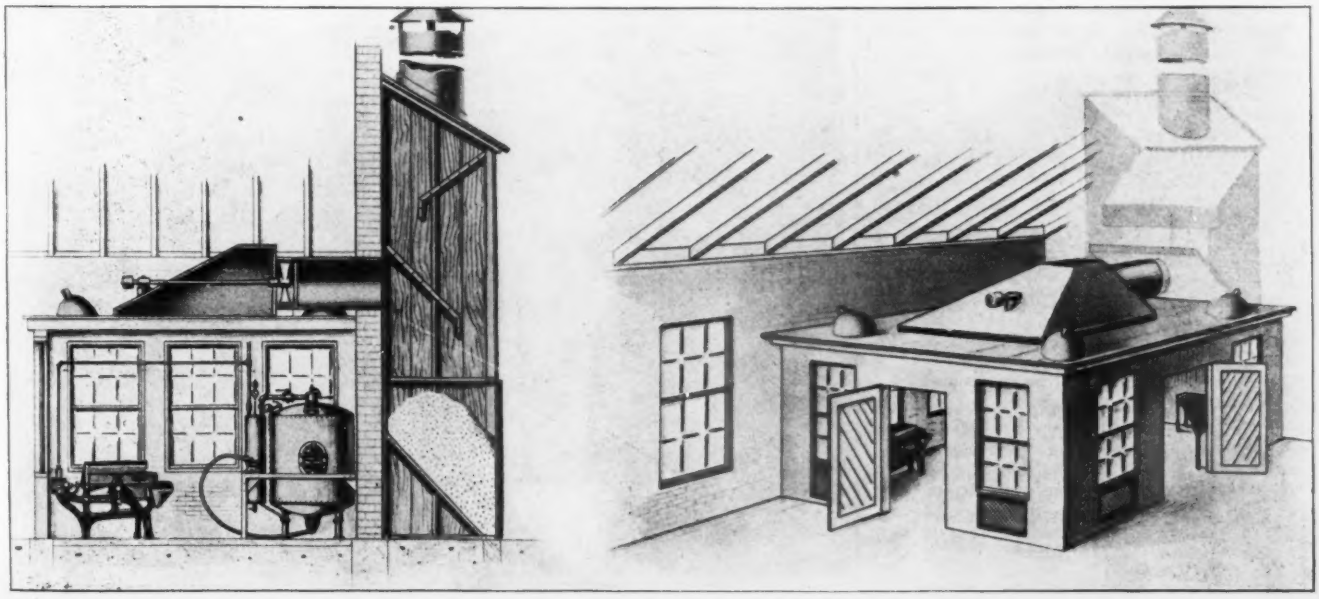

FIG. 1—STANDARD ARRANGEMENT FOR AN INEXPENSIVE SAND-BLAST ROOM FOR AN AVERAGE FOUNDRY

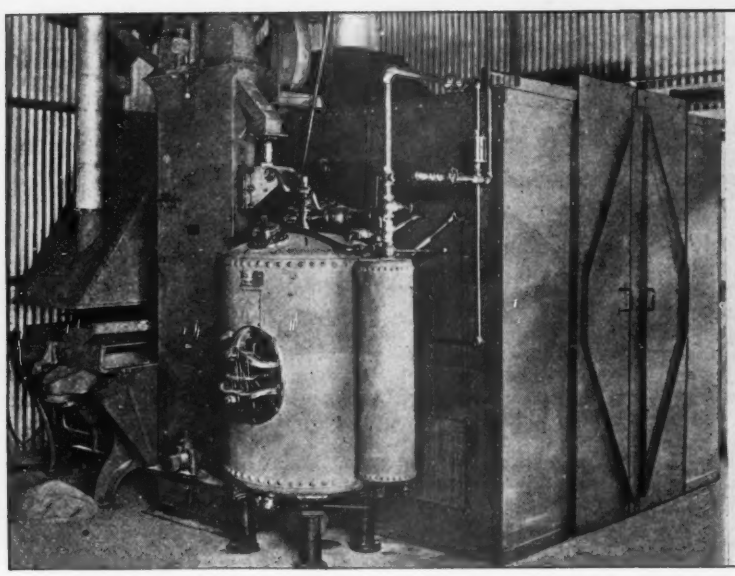

FIG. 2—STEEL PLATE SAND-BLAST ROOM WITH PRESSURE MACHINE

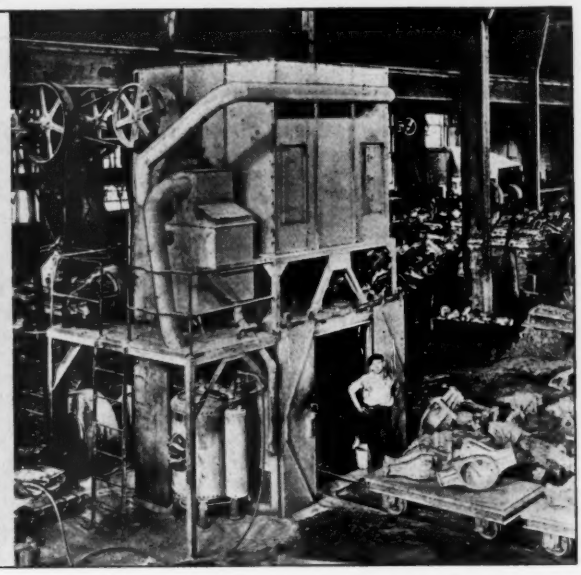

FIG. 3—SAND-BLAST ROOM WITH SAND SEPARATING AND ELEVATING SYSTEM

tion of a plan suggested by the sand-blast engineer, with a saving of over $6000 in the initial cost. Who was the sufferer, and whose was the loss of six weeks of "valuable time"? Certainly not the manufacturer.

Obviously in the installation of sand-blast equipment the foundryman must turn to the manufacturer. The manufacturer's qualifications to give the service desired must include: Long and varied practical experience; an organization for the design, manufacture and installation of sand-blast equipment; physical and financial facilities for production; and a line so complete as to permit of unbiased counsel in suggesting equipment. A representative should visit the plant and make observations of conditions and operation. Men of the foundry organization who will be the deciding factors, should discuss the subject fully and thoroughly until their minds are met on what is needed. With plans and suggestions prepared the foundryman should go over them again with the sand-blast engineer until entirely conversant with the plan, the operation of the installation and the results to be obtained. Two or three conferences along these lines will save time, give a more intelligent understanding than is possible by proxy or correspondence and secure an investment that will pay a constant return. Keep the problem away from the purchasing end for by training they can't see beyond the invoice figure—and money is not made there. Measure the price of sand-blast installation by the cleaning cost per ton.

Many Sizes and Types

The advantage, to say nothing of necessity, of such thorough consideration will be apparent when it is understood that one manufacturer alone standardizes over 20 different types and sizes of sand-blast machines, exclusive of innumerable designs that are constantly being produced to meet special requirements. Some understanding of the underlying principles, functions and operation of various types of sand-blast machines and installations will be of aid.

Basically sand-blast machines will divide into four general groups as follows: Hose machines; cabinets; barrels; and tables. The method of operation may be either the direct pressure, the suction (syphon) or the gravity systems.

In direct pressure systems the sand is under pressure in a sealed container, sand and air being discharged in combination without expansion through a hose nozzle giving the greatest velocity and highest efficiency possible. The majority of hose machines are of the direct pressure type, indeed, the first application of sand-blasting was the hose machine type and it is still used without exception in sand-blast room installations. It offers a range of application that is possible with no other type. For a line and character of work that is varied and of medium volume it undoubtedly represents the most satisfactory equipment. Where the tonnage is large and the pieces are of a weight and size too great for convenient handling it is indispensable. The use of the hose machine demands some enclosure and experience has shown the wisdom and economy of a well ventilated and well lighted room for the purpose.

Sand-Blast Rooms

While the cleaning cost will always be reduced by mechanical methods of handling the work and the abrasive for reuse, a convenient room can be provided with small outlay and may be built of rough lumber as shown in Fig. 1, with an exhaust fan in the ceiling or wall, carrying the dust-laden air into a settling box or chamber that will retain the heavier particles. The lighter material is carried off into the atmosphere.

The inclusion of mechanical handling and screening of the abrasive makes a steel room most advantageous and economical. The simplest of these provides for the location of the sand-blast outside the room which is left free for the blasting operation, with controls extending inside to within easy reach of the operator, as illustrated in Fig. 2. A mechanical

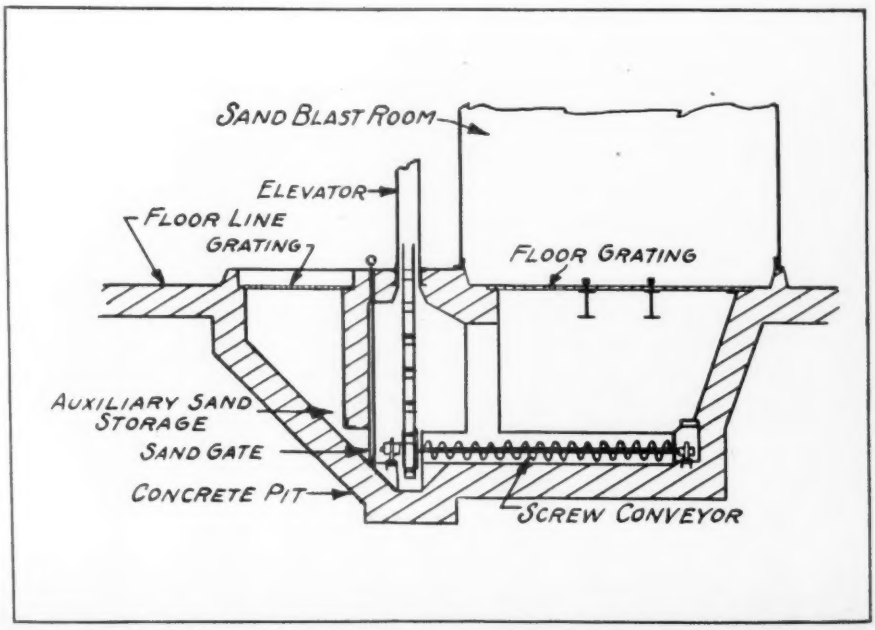

FIG. 4—SECTIONAL PLAN OF FOUNDATION FOR SAND-BLAST ROOM, SHOWING CONVEYING AND ELEVATING EQUIPMENT

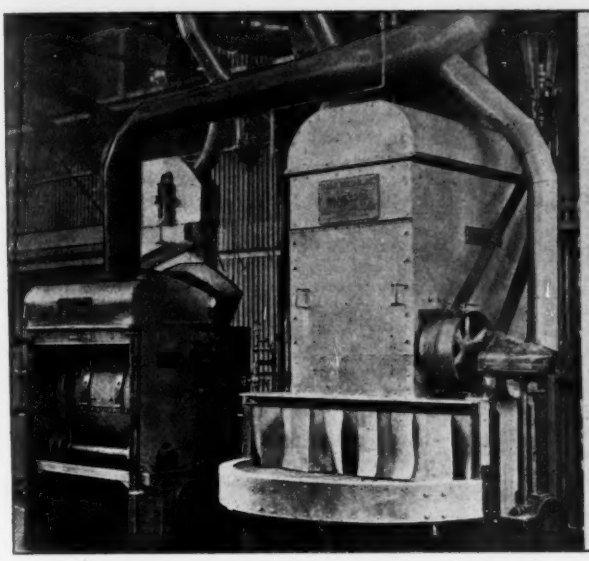

FIG. 5—COMBINATION SAND-BLAST ROOM AND BARREL INSTALLATION

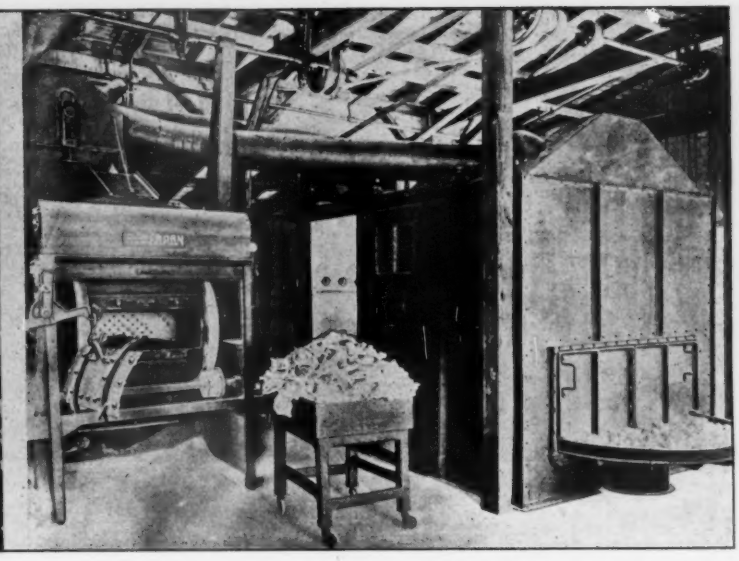

FIG. 6—AUTOMATIC REVOLVING TABLE SAND-BLAST MACHINE

separator, driven by a powerful air motor, at one operation removes both fine and coarse material. The clean, sharp abrasive for reuse is delivered by an elevator to a sand storage bin above the sand-blast machine for refilling. In this type of room the spent abrasive is shoveled from the floor to a chute in the side of the room connected to the separator.

Expansive System

As the daily tonnage rises, the capacity of the sand-blast installation expands, and without added cost for labor, in proportion as appliances are added for the mechanical handling of the abrasive, and the work is properly handled and routed. The problem of handling the abrasive can be met by a grated floor in the room through which the spent abrasive falls to a conveyor below which carries it to the elevator boot. Built into the elevator system should be an efficient separating system, preferably a combination of mechanically operated screens, with an exhaust to remove the fine material. Thus both the coarse material that will not pass the nozzle and the disintegrated abrasive, core sand and all fine material without abrasive qualities are removed. This is shown in Fig. 3.

The clean, sharp abrasive passes to a storage bin for refilling the machine, which is controlled from within the room. The waste material is carried to a bin with the outlet at convenient points. An auxiliary sand-storage bin, a part of the foundation, loads through a grated opening outside the room, and carries several days' supply of abrasive, which is fed to the system through a gate as renewal is required. See Fig. 4. This continuous operation also may be accomplished by placing the sand-blast machine itself in a pit beneath the grated floor, but the depth required for properly proportioned hopper to accommodate the entire floor area and the separating system results in a depth of pit and foundation that while showing no economy in cost even by the elimination of the conveyor and elevator, is frequently impracticable due to water conditions and also it makes impossible the advantage of the auxiliary sand-storage for handling the abrasive in volume. Where floor area is at a premium this system may be found advantageous.

Light and ventilation are of course necessary adequately to handle any considerable volume of work. Electric light fixtures with parabolic porcelain enameled reflectors will properly diffuse light equally to all points, and if fitted with protective fronts a perfect protection is afforded the lamps from flying abrasive.

Ventilation which should be ample will of course be governed by the requirements of the work in hand. No hard and fast rule can be suggested for this, but a constant change of air is required and this should be a minimum of say four to six changes per minute for the general run of brass and malleable castings, six to eight changes for cast iron and 10 changes for steel. A slow-speed exhauster of low horsepower requirements is most satisfactory as well as most economical.

Exhausting Dusty Air

Some diversity of opinion is expressed as to the most satisfactory system for removing the dust-laden air. Theoretically it is desirable to keep the dust in transit below the operator's head, and this theory creates some adherents for the down-draft system whereby the dust-laden air is drawn downward through the grated floor. Failure in practice to keep the gratings clear, however, seriously retards circulation and experience has demonstrated that more positive results are obtained from an up-draft, where there can be no interruption to the draft, and generally better operating conditions are secured. As the dust is created where the blasting operation takes place, well above the floor line, and with a general tendency to rise, the up-draft system removes it without change of direction.

In considering claims for conditions provided within sand-blast rooms common sense tells us the dust

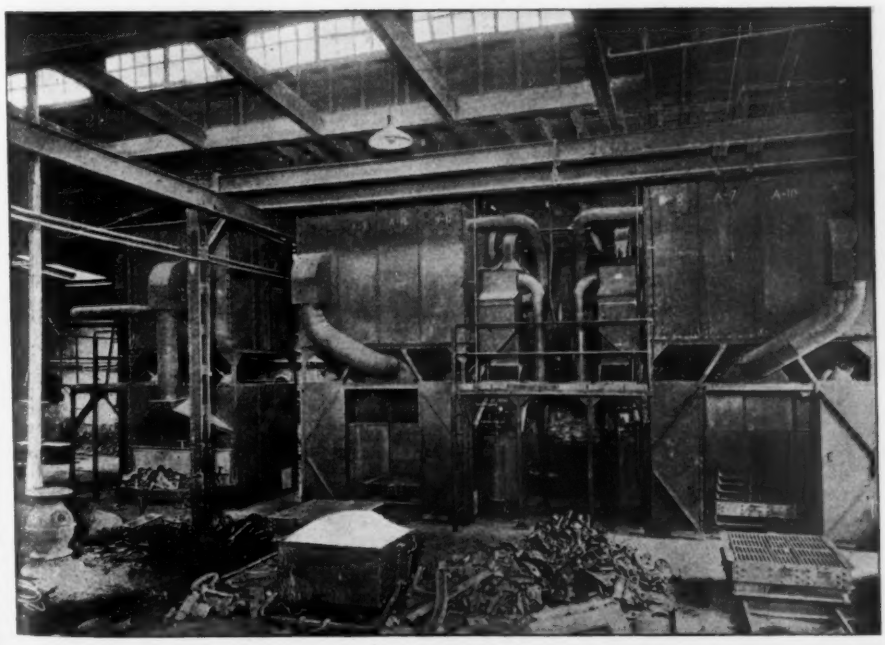

FIG. 7—SAND-BLAST ROOM INSTALLATION EQUIPPED WITH TABLE AND CARS FOR HANDLING AND REMOVING WORK

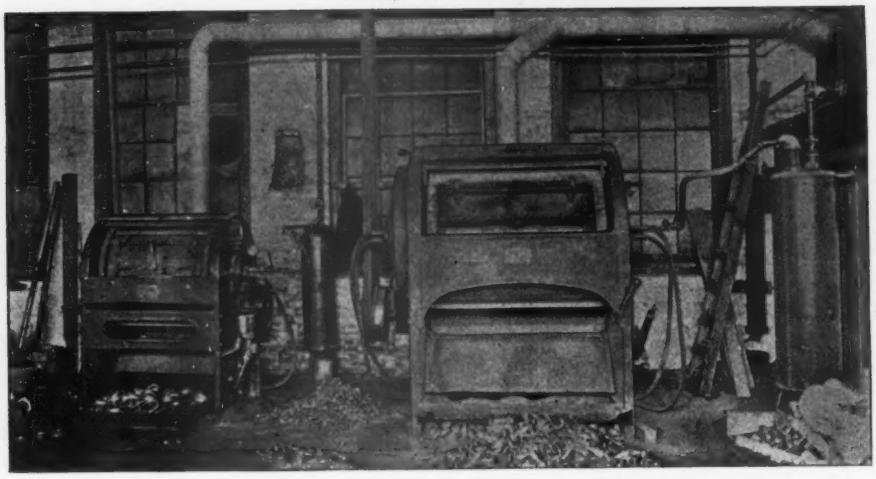

FIG. 8—SUCTION TYPE SAND-BLAST BARREL

is there and no improvement is possible over its removal as fast as created. Not only is this rapidity of removal essential from the standpoint of hygiene and sanitation, but equally so to provide clear vision for efficiency in cleaning. Obviously protection for the operator from the dust-laden air and the flying abrasive other than afforded by the exhaust system must be provided. The most satisfactory device is a dust-proof ventilated helmet. Air is introduced into the helmet from the compressed air line, to which the helmet is connected by a small flexible hose, weighted over pulleys to take up slack in any position and permit ease of movement to the operator.

Handling Systems

The dust may be collected by a cloth screen dust arrester. Dust is created in such volume as to be not only an annoyance to shop or neighborhood, but its confinement is a matter of economy as the cleaned air after passing through the arrester can be returned to the room or to shop ventilating system, a feature of considerable importance in winter weather.

The rooms, of such size and arrangement as individual requirements dictate, should be equipped as the product demands with a track of cars with grated tops on which the work can be blasted as well as transported without other handling, or where a monorail system is used, this can be carried into the room and the pieces cleaned while suspended. Where the material is all or partly in the nature of bench work a rotative table installed in one side of the room is a decided advantage.

Some foundries having sufficient tonnage of both large and medium work have obtained a reduced cleaning cost by installing a battery of two or more rooms, equipping each as the proportions of the work demand with car or table, as shown in Fig. 7.

The rotative tables are up to 90 inches in diameter and have a high partition across the center that completely closes the aperture in the room structure. The material to be cleaned is loaded onto the exposed half of the table, outside the room, by common labor; the table travels on ball bearings and is turned by the sand-blast operator to expose the cleaned work for unloading and to bring new work into the room for cleaning.

The entire time of the sand-blast operator should be devoted to the cleaning operation only. The handling of the work to and from the room should be done by other help. Frequently two operators are worked in a shift. While one is sand-blasting the other is delivering cleaned work and bringing up the new material for cleaning. Each thus handles and cleans his own work, which, in addition to giving continuous operation of the sand-blast, provides a periodical change of occupation.

Where the work is of a character requiring room cleaning and still all within the range of sizes to admit of cleaning on the rotative table; the hygienic table cabinet, Fig. 10, offers advantages. A semicircular cone-top steel cabinet fits closely to half the circumference of the table, the upright partition across the center of the table entirely closing the rear of the cabinet leaving half the table exposed. In the front of the upright wall of the cabinet and extending the entire length is an opening covered by a flexible sectional rubber curtain that retains the abrasive within the enclosure and through which the hose nozzle from a direct-pressure blast is directed onto the work to be cleaned. Unobstructed view of the work and interior of the cabinet is provided through a screen covered opening in the cone. Electric light fixtures provide satisfactory illumination within the cabinet.

Table Cabinet Reduces First Cost

The work is handled as with the room table. This device offers all the efficiency of a room installation for work within its limits, with the added advantages that the operator works in the open, without contact with dust-laden air as in the room. No protection is required other than that afforded by the cabinet itself. The cabinet having less cubical contents than a room, the smaller ventilating system required helps to keep down the first cost of the installation. As with room installations, the sand-blast machine can be located on the floor level with elevator and separator for continuous operation, or a pit below the cabinet can be provided for returning the abrasive to the machine by gravity, as shown in Fig. 12.

The conditions and equipment considered in the foregoing deal only with large work, but no less essential is the handling of small and light work of both the big foundry and the plant that devotes its production to work that is not adapted to handling in the room sand-blast. As the size of the work decreases the efficiency and likewise economy of the hose sand-blast diminishes and more economical devices according to the quantities and character of the pieces are found in cabinets, barrels and automatic revolving tables. Each of these are distinct in their inherent characteristics of design, operation and application.

Adapting Types to Work

The barrels and automatic tables are capable of handling the entire output of the small or medium-sized foundry within the limits of their capacities, and all of them are profitable in combination with a room installation to the large foundry with a varied line of work.

The cabinet sand-blast, a self-contained unit ready for instant use when attached to the air line, is essentially an auxiliary in foundry sand-blasting. The blasting operation is of the suction or syphon type. The abrasive is brought to the nozzle by a partial vacuum created by a jet of compressed air. The air and abrasive are discharged in combination through the sand nozzle, which, being of greater diameter than the air jet, admits of expansion with correspondingly decreased velocity, so that while the blasting efficiency with equal gage pressures is below that of the direct-pressure type, it is a most satisfactory device for special or precision

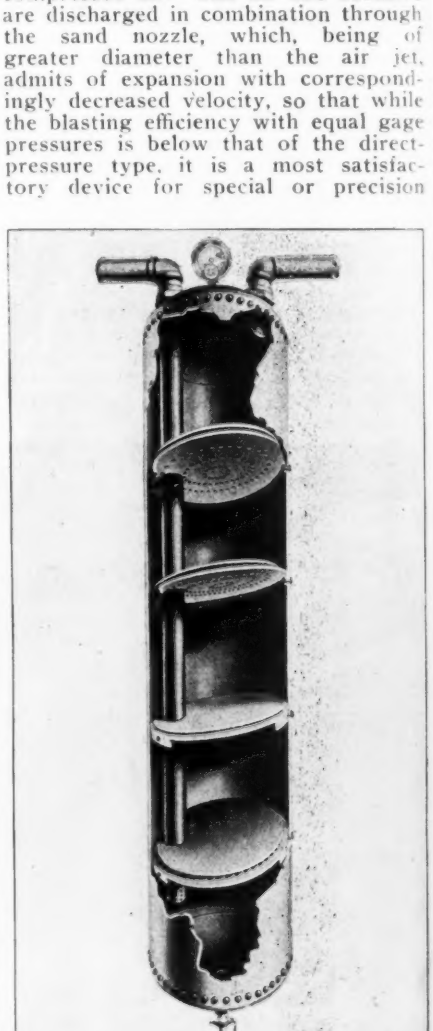

FIG. 9—SEPARATOR FOR ELIMINATING MOISTURE FROM SAND-BLAST AIR

work not economically handled by a large installation.

The floor of the cabinet being perforated, the spent abrasive flows back to the feed box, giving a continuously operating machine. Electric light fixtures make it available for use either with natural or artificial light and openings are provided also for connections to the exhaust system.

Sand-Blast Tumbling Barrels

For small work in any considerable amount, and particularly where no detriment to the pieces would result from the slow rolling process, no device shows the speed and economy of the barrel sand-blast. While the first adaptation of this system, consisting of placing the nozzle of the hose sand-blast in the ends of a revolving barrel, is still seen in some types, refinements have brought the barrel sand-blast a secure position of its own. There are different types of barrels and selection should be made with reference to the character of the work to be cleaned, both as to size, shape and degree to which the sand is burned to the casting.

For small brass and malleable work that has been cleaned before annealing, the suction type, Fig. 8, will be found entirely efficient and has the advantage of a single self-contained unit with low first cost. Three or four nozzles according to size cover the entire length of the drum and in the highest developed types the nozzles are adjustable as to direction to different characters of work that vary in their "riding" position within the drum. This construction, too, permits the elimination of projecting nozzles that may catch and damage the work or the machine, as well as offering an in-swinging door that allows removal of the load by dumping without raking or other handling.

Large castings of either brass, iron or steel demand a heavier design and construction, and the combination of such a barrel with a room installation will take care of a considerable output of varied work. Such an installation is shown in Fig. 5. The blasting action is of the gravity type, the abrasive being delivered to the nozzles by mechanical action and gravity; no portion of the force of the air is expended in raising the abrasive, and as the ratio of the air jet to the sand nozzle is greater than in the suction system, less expansion of the air takes place with proportionately increased blasting efficiency. The nozzles are located in each end of the drum, leaving the interior entirely unobstructed so that the size of pieces that can be cleaned is limited only by the dimensions of the door opening. The abrasive passes through perforations in the drum and falls into a hopper that conveys it to the elevator boot. As it is delivered from the elevator, a strong exhaust removes the fine light material, and vibrating screens reject everything that will not readily pass the nozzle, giving a continuous flow of evenly graded, clean, sharp abrasive. For the foundry whose product is of a size and character that will admit entirely of barrel cleaning, there is no one other device that is as economical and satisfactory.

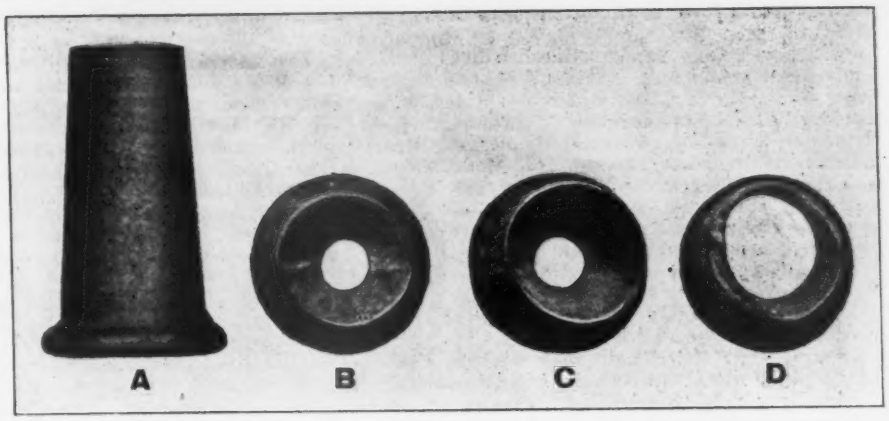

FIG. 11—NOZZLE WEAR HAS A GREAT EFFECT ON AIR CONSUMPTION

Automatic Revolving Table Type

There are classes of work that by reason of shape do not adapt them to barrel cleaning. This includes precision work or pieces that are so light and fragile as to not admit of this method of sand-blasting, and are yet too small for individual cleaning to advantage with the hose machine in room installation. For this character of output the automatic revolving table sand-blast, Fig. 10, has found high favor. A grated-top table half exposed and half housed revolves at a slow speed. Within the housed portion a series of nozzles, fed from a direct high-pressure hose blast, are oscillated in adjustment with the varying peripheral speeds of the table so that all points are brought with equal duration within the path of the blast stream. The pieces to be cleaned are placed on the exposed portion of the table as it revolves; they are turned as required and removed when cleaned. A flexible sectional rubber curtain permits passage of the pieces to and from the housing while retaining the abrasive within the enclosure and protecting the operator from dust and flying particles. An elevator and separator, as in the barrel, provide for cleaning and feeding the abrasive, making a continuous feed, self-contained unit. The installation of barrel and table together is frequently found advantageous.

Provision in all of these devices is also made for connection to the exhaust system, and it may be noted that exhaust for the cabinet, barrel or table, or all in combination, with grinders as well where desired, can be connected to the exhauster-arrester system of the room installation.

The more modern types of any of the devices described are equally adaptable without change, by slight adjustment, to use of either sand or the metal abrasives. With the constantly increasing use of the sand-blast the question of the most satisfactory abrasive is naturally being given more attention. Like pressures, no hard and fast rule can be laid down, but each problem must be solved by existing conditions, requirements and if need be, by experiment. Each producer of abrasive claims advantages for his product and there is no question but what each has advantages peculiar to itself.

Abrasive Materials

The metal abrasives have many times the life of sand, do not require large storage capacity and create less dust in use. Their comparatively high initial cost demands careful reclaiming methods, as any considerable daily loss soon wipes out the saving their long life affords. To some lines of work they do not successfully lend themselves without after-cleaning of the pieces, as the fine metallic dust adhering by force of the blast creates defects in galvanizing, plating, etc. Moisture in the air lines too, is a decided deterrent to the use of metal abrasives, due not only to the fact that they do not flow freely when

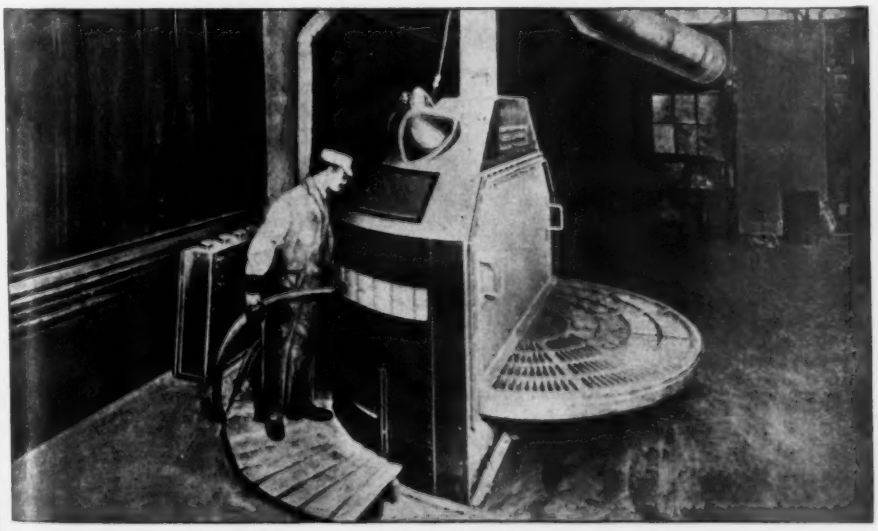

FIG. 10—REVOLVING TABLE CABINET SAND-BLAST INSTALLATION

damp, but may readily rust into a solid mass.

Of the various sands offered silica and ocean sands only have the sharpness and hardness to make a satisfactory sand-blast abrasive. At the same, or even an advanced cost, undoubtedly the silica sands would have a general preference. Owing to the restricted areas of production, however, freight rates operate against their use at any considerable distance from the source of supply. It is only by a trial of each that an intelligent selection of available sands can be made, and some initial expense in comparative tests of all the various sands and metal abrasives will undoubtedly be fully returned in satisfactory results and economy of sand-blast operation. Highest blasting efficiency from any abrasive, however, may only be anticipated when it is evenly graded, dry and free from loam and dust.

Tracing Operating Troubles

Operating troubles may usually be traced to three general causes, air pressure, moisture and abrasive. An installation that fails to provide for adequate control and regulation of these can hardly be called complete or expected to give maximum results.

All other factors being normal, air pressure governs results. When it is remembered that results at 20 pounds pressure are but half that at 56 pounds; at 30 pounds half that at 64 pounds, and at 40 pounds half that at 72 pounds, it is seen that the increase in output and saving in labor will demand the maximum pressure that the character of the work will permit. Obviously soft brass will not stand the pressure required for cleaning steel, nor will the molding sand fuse and burn to the casting in a degree to demand such high pressure.

Air volume should be ample and the flow steady. Air means horsepower, which in turn costs money, and the air volume should be restricted to the minimum to obtain the required results. As the flow of air increases four-fold with increases in the diameter of the nozzle, restriction at this point is most essential. It means not only a constant saving in operating cost, but in the case of limited air supply, increased air flow may cause a drop in pressure with a corresponding reduction of output.

This feature cannot have too careful attention. For example, a new nozzle with ¼-inch diameter opening, *A* and *B*, Fig. 11, flows, at 80 pounds pressure, 85 cubic feet of free air per minute. If the nozzle enlarges with use, *D*, Fig. 11, an increase of 1/64-inch increases the air flow by 12.5 per cent. With a 1/32-inch increase in diameter the air flow increase is 27 per cent and by a 1/16-inch increase in diameter the air flow has increased 56.5 per cent. The nozzle should retain the original inlet size as it wears at the discharge end, as shown at *C*, Fig. 11. Not only economy dictates this but it permits of predetermined air and horsepower requirements.

It is rather past conception that anyone would permit water to get into the gasoline tank of his automobile. The results would be disastrous, but how many are making provision to eliminate the water from their compressed air lines? In many cases, the air passes the "moisture" stage, and trouble is immediately experienced.

Moisture is detrimental to all air-operated tools and as it is variable with weather conditions some provision for its elimination before delivery to the sand-blast or to other tools is the truest economy. Various devices are produced for this purpose and where the moisture volume is not abnormal a simple separator, consisting of a tank fitted with a series of solid and perforated plates placed at a slight angle from the horizonal is effective. The air supply pipe is carried to the bottom of the tank and capped, the air being released through tiny perforations aggregating the area of the pipe diameter. From the bottom of the tank it passes through the openings in the perforated plates striking the solid plates and passing around the outside to the next series, this operation being repeated several times until finally it reaches the top of the separator and flows through the outlet to the sand-blast machine.

The principle involved lies in the fact that when air at high pressure and velocity is compelled to take an abrupt change of direction, the heavier particles of air containing the moisture, by their momentum, will strike the walls of the apparatus in which this change of direction takes place. This causes compression of the particles of air which tends to separate out the moisture and deposit it on the walls of the vessel.

Where the moisture is excessive, even if only at certain seasons, an after-cooler or reheater is a necessity.

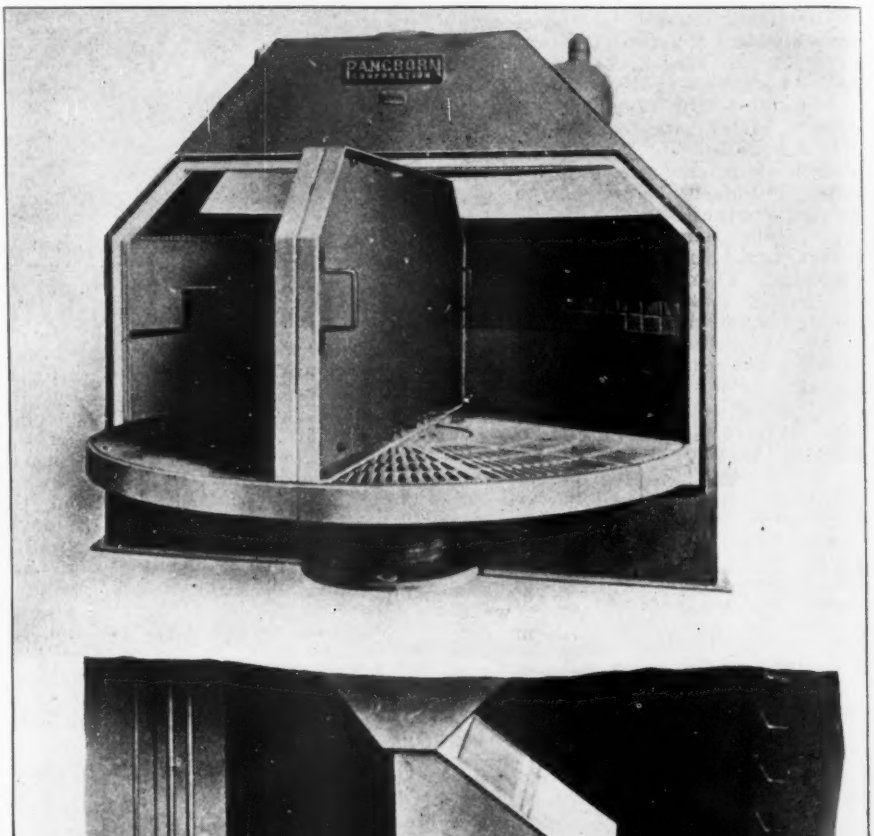

FIG. 12—CABINET TYPE MACHINE SHOWING PIT INTO WHICH THE ABRASIVE FALLS AND IS RETURNED TO THE MACHINE BY GRAVITY

While the after-cooler is most effective, some plants have found satisfactory relief in the reheater, although its function is in no wise to eliminate moisture.

Each function in the operation of a sand-blast is to an extent dependent on the perfect operation of the others. Therefore maximum results cannot be anticipated from poor or powdered abrasive even with dry air at high pressure. Both sand and the metal abrasives show some disintegration with the use and the fine dust together with core and molding sand and all fine material must be removed constantly from the abrasive. This material has no abrasive ability, but it consumes air just the same. Clean, sharp, dry abrasive graded to the requirements of the work will increase the output amazingly. A complaint is recalled where investigation developed that the owner had mixed fine plumbago with a metal abrasive, anticipating a desired finished appearance, but the admixture of this material with fine metallic dust from the abrasive, unscreened before reuse, and an abundance of moisture had formed a bond that rusted into a solid mass requiring a cold chisel for its removal from the machine. The complaint in this case was that the sand-blast would not operate. A thorough understanding and application of basic principles will save time, worry and expense. The help of a competent service man will often more than repay the expense entailed particularly if some one in authority in the foundry organization will co-operate.

Foundry Built and Operated on Battlefield

IN improvising a foundry behind the lines in France, burning waste oil to reclaim scrap metal and then recasting the ingots into parts for damaged engines of war, British infantrymen, who formerly were foundry workers, displayed signal ingenuity, according to an account of their experiences read recently by Capt. A. E. Plant at a meeting of the Institute of Metals in London. While Capt. Plant's paper was of a nontechnical nature, the extraordinary difficulties encountered in setting up a foundry on the threshold of a battlefield and converting the flotsam and jetsam of war into armament developed certain features the institute considered of scientific interest.

The first foundry in connection with the repair shops of the British forces in France in 1915 consisted of a corrugated iron shed, 25 x 25 feet. There was one pit furnace, about 20 x 20 inches, built of firebrick. The only source of supply was the scrap-heap in the repair shop. Finally, an oil furnace of 500-pound capacity was installed and this was operated with a tar oil until the local dealer in the oil put up the price, when the foundrymen decided to experiment with waste oil and grease that had accumulated from the cleaning out of the engines and gear boxes of cars and lorries that were undergoing repairs in the shop. As the consistency of the oil varied considerably it was all poured into a 600-gallon tank and allowed to settle; the sediment was drained off at the bottom, the lighter oil flowing through small holes in the top of a special compartment. This oil gave better results than did the tar oil and for two and one-half years nothing but waste oil has been used in this foundry.

Captain Plant stated that the oil consumption with a charge of 350 pounds of heavy gun-metal scrap, the usual charge, averaged above 9½ gallons and the time taken to melt, the furnace being first heated, one hour. All the metal was run into ingots before being recast. A fair degree of success was had with this furnace in melting all the scrap metal except iron, the furnace failing to produce sufficient heat for the latter purpose.

The next step in this do-it-on-the-spot plan was the building of a vertical furnace taking up to 100-pound crucibles still using the waste oil as fuel. The furnace was circular in design, the casing being made of cast iron and the lining of firebrick. The blast-pipe had a jet 1½ inches in diameter connected to it and the jet entered the furnace at such an angle that the issuing flame struck the furnace wall at a tangent, a whirling motion thus being imparted. The fuel oil was contained in a 15-gallon tank fitted with a hand-air pump and a pressure gage, a 5-pound pressure being maintained when the furnace was in operation.

"The melting times varied somewhat owing to the variation in temperature and quality of fuel oil, and consequently the consumption was not constant," said Capt. Plant. "An average time to melt 80-pound gun-metal ingots was 40 minutes, after the furnace had been heated up. When melting aluminum ingot an 80-pound crucible took about 15 minutes, the furnace being hot initially.

"The essential points to watch in the use of waste oil are freedom from dirt, water, or other foreign matter, and the fact that it must flow freely to the jet.

"Castings in iron, gun-metal, phosphor-bronze, brass, and aluminum are produced in the same building, a portion of the floor being reserved for bronze and brass, as it is found that aluminum and iron castings can be successfully made on the same floor. All the scrap metal used is melted and first run into ingots, also the borings of gun-metal and aluminum from the machine shop. Over a ton a month of new white metal is made for lining and making die-castings for petrol engine bearings. The monthly average weight of castings produced varies from five to eight tons, and the castings number from 1600 to 2500, being varied in character and weighing from a pound to nearly a ton, according to the demands.

"Our two cupolas, fans, sand-mill and furnaces, with the exception of the first oil furnace, were made on the premises out of scrap material.

"A few examples of the class of work turned out will indicate its varied nature: Bushes in gunmetal, cast iron Daimler water-jacketed cylinder heads, cast iron water-jacketed induction pipes, aluminum pistons, cast iron piston ring blocks, all kinds of bearings, brackets, pipes, and flanges in all metals, shop tools and jigs, tables for hydraulic pressures, aluminum pulley wheels and parts of radiators.

"It is clear that by using materials on hand for the production of certain parts for chassis that have become superseded since the war, a considerable saving in time on repairs can be effected, because the makers have in many cases exhausted their stock of spares for these prewar chassis.

"The chief points in favor of using oil for fuel in the circumstances under which we are placed, are as follows: It is only necessary to have the furnace in operation about a quarter of an hour before the crucible and charge are introduced; it often happens that the furnace is not required all day, and it can be put in and out of operation quickly; temperature control is easy and consistent; saving in transport of solid fuel and utilizing waste oil on the spot."

High Sulphur in a Chill Mixture

By W. J. Keep

Question:—We run a chill mixture with 30 per cent steel as a substitute for white charcoal iron. We are troubled with brittleness in the metal after it is cast. An analysis showed an excessive amount of sulphur, namely from 1.40 to 1.60 per cent and low manganese, from 0.20 to 0.35 per cent. We always have attributed brittleness in the chill to high sulphur and low manganese. Is this correct? We have increased the manganese, but we cannot reduce the sulphur to 0.09 to 0.10 per cent. When we use white charcoal iron in the mixture the sulphur seldom exceeds 0.08 to 0.09 per cent. Can this same analysis be duplicated in a chill mixture with 30 per cent steel? We make chilled rolls that are about 3 inches in diameter and 2 inches high. The surface is chilled about 3/8 inch. The silicon averages 1.50 per cent and the phosphorus 0.40 per cent. The center of the rolls must be sufficiently soft to drill.

Answer:—The substitution of steel for white charcoal iron should not materially increase the sulphur. However, it is advisable to ascertain where the increased sulphur comes from. First analyze the coke, then the steel scrap and if you use limestone or other flux, also analyze this material. An increase in the amount of manganese generally causes it to combine with the sulphur in a less objectionable form and sometimes this combination passes off with the slag. Steel scrap should contain less sulphur than white charcoal pig iron. No mixture should take up as much sulphur as indicated by you unless it comes from the flux.

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Co-operation and Conservation

IF any one lesson can be drawn from so tremendous an affair as the recent foundry convention and exhibition in Milwaukee, it is that at last the foundry industry is waking up to the benefits to be derived from co-operative effort. The whole big foundry and machine exhibition in itself was a demonstration of the good results which flow from the free interchange of ideas and information on foundry production problems. The same lesson was driven home at each of the 15 professional sessions held during convention week. This great theme however, was rounded out, emphasized and finished off in the eloquent remarks of W. H. Manss of the war industries board at the meeting of foundry equipment manufacturers. All of those who were privileged to hear Mr. Manss were profoundly impressed with the weight of his arguments, backed up as they were by facts and figures of transcendent importance.

War has forced us to co-operate. It is to be hoped that peace will not again set back the hands of the clock and destroy the advantages which industry at great sacrifice has wrung from the past year's events. In the various branches of the foundry industry in particular there is all too little natural cohesion, and it will be necessary, therefore to cultivate the tree which bears the fruits of co-operation as carefully after the war as we have during these troublous times.

Co-operation in an industry, as Mr. Manss pointed out, in the modern sense does not mean price agreements, trade restrictions or secret arrangements. On the contrary, it sounds the death knell to trade secrets and flourishes only in the full light of day with all transactions on top of the table. One of the greatest benefits of co-operation is the opportunity it offers for effective and practical conservation of raw materials, labor and industrial energy. The foolish and frivolous wastes which grow up in any industry as the legitimate offspring of unregulated competition, can be eliminated almost completely through effective co-operative effort and the resulting conditions benefit both the producer and the consumer. In fact, the savings which industry has realized from enforced wartime co-operation are so tremendous that it must be self-evident even to the most superficial observer that the old theory of business economics of our fathers, based on unlimited, unrestricted competition of the every-man-for-himself and devil-take-the-hindmost variety is thoroughly outworn, threadbare and discredited. Let us hope that the dawn of the better day for business which now shows so much promise will not be darkened before noon. Two factors threaten the continuance of existing conditions, namely, the destructive activities of political demagogs and the natural inability of business men to work together except under the stress of a powerful external cohesive force. Of the two pitfalls, the latter appears at present to be the more formidable menace to co-operation.

COMINGS AND GOINGS OF FOUNDRYMEN

H. D. Megary has been elected secretary of the Chicago Pneumatic Tool Co., Chicago, to succeed W. B Seelig, resigned.

James D. Robertson, sales manager of the Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, has been elected a director of the company.

W. C. Minier has been placed in charge of the Cleveland office of the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.

John J. Agnew, formerly with the Pittsburgh Iron & Steel Foundry, Midland, Pa., has joined the sales staff of the Mesta Machine Co., Pittsburgh.

Francis J. McGrail has resigned as foundry superintendent for the Struthers-Wells Co., Tonawanda, N. Y., to become general superintendent of the Walker Foundry Co., Erie, Pa.

E. F. Parks has been appointed general superintendent of the plant of the Universal Winding Co., Providence, R. I., to succeed W. A. Booth resigned.

A. G. La Pierre has been appointed traffic manager of the Chicago Pneumatic Tool Co., Chicago, and F. O Southbrook, manager of the order and production department.

Charles B. Wilson, formerly vice president and general manager of the Ferro Machine & Foundry Co., Cleveland, has been elected vice president in charge of production for the Curtiss Aeroplane & Motor Corp., Buffalo.

Walter H. Wood, president of the Wood Foundry Co., Florence, N. J., has turned over the Florence public library building, which he founded a few years ago, for an emergency hospital.

J. F. Shea has resigned as foreman of the pattern shop operated by the Lake Torpedo Co., Bridgeport, Conn., to accept a position as works manager of the Delta Machine & Foundry Co., Brooklyn.

Charles M. Smith, formerly affiliated with the Detroit Steel Casting Co. and the Michigan Steel Castings Co., Detroit, has been appointed superintendent of the foundry operated by the Nelson Bronze Co., Saginaw, Mich.

H. W. Johnson has been appointed factory manager of the Ecorse Foundry & Machine Co., Ecorse, Mich. Mr. Johnson formerly was manager of the Fairview Foundry Co., Detroit, and recently was connected with the Lakeside Foundry Co. of that city.

J. Leichman has been appointed superintendent of the foundries operated by Rathbone-Sard & Co., at Albany, N. Y., and Aurora, Ill. Mr. Leichman formerly was affiliated with the American Locomotive Co., Schenectady, N. Y.

W. W. McMillan and Frank P. Anderson, formerly connected with the Sharon, Pa., plant of the National Malleable Castings Co. have been transferred to the main office of the same company at Cleveland. Mr. McMillan has been appointed purchasing agent and Mr. Anderson will be his assistant.

Albert W. Russel, formerly treasurer of the Russel Wheel & Foundry Co., and president of the Russel Motor Axle Co., Detroit, has been appointed a member of the war credits board to succeed Fernando P. Neal, resigned.

George M. Morrow, Jr., president of the Birmingham Machine & Foundry Co., Birmingham, Ala., has been appointed lieutenant colonel in the United States army. Mr. Morrow is a graduate of West Point.

William J. Fairbairn, secretary of the Milwaukee Metal Trades and Founders' association, has been chosen by the department of labor as one of three industrial advisors to the district exemption board at Milwaukee.

Herbert J. Boggis, vice president of the Taylor & Boggis Foundry Co., Cleveland, is one of 15 men chosen to serve as the employers' advisory committee of the Cleveland employment service, under the new federal labor administration.

C. F. Knowlton, for many years assistant superintendent of foundries of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and who has been located at the Cleveland foundry for about eight years, has been appointed superintendent of the Westinghouse foundries to succeed Benj. D. Fuller, who recently resigned.

Clement A. Hardy, for many years sales manager of the Whiting Foundry Equipment Co., Harvey, Ill., and who recently resigned and disposed of his interest in this company, has established an office in the Railway Exchange building, Chicago. Mr. Hardy is engaged in consulting and contracting engineering work for foundries and machine shops, with particular reference to the installation of tools and equipment.

E. L. Tuck, formerly superintendent for T. McAvity & Sons, Ltd., St. Johns, N. B., Canada, has been engaged by the Dayton Molding Machine Co., Dayton, O., in an important sales capacity. Mr. Tuck will cover middle western territory. He has had considerable experience in the manufacture of semisteel shell for both the United States and Canada, together with a wide general experience in foundry practice.

Carl P. Seylor, vice president of Hubbard & Co., Pittsburgh, and president of the Beall Brothers Tool works, Alton, Ill., heads interests who have secured control of the Bronzbraswyt Metals Co., Pittsburgh. Mr. Seylor now is president of the company, succeeding T. D. Maloney, while H. W. Herman, sales manager under the old management, becomes vice president and general manager and Carl J. Seyler vice president and secretary in the new management.

Lieut. Col. Robert P. Lamont, who, in civil life, was president of the American Steel Foundries, Chicago, has been made chief of the procurement division of the army ordnance department, Washington, D. C., to succeed Brig. Gen. Samuel McRoberts. It has been announced by Maj. Gen. C. C. Williams, chief of ordnance that Brigadier General McRoberts is to undertake important work on the staff of the chief ordnance officer with the American expeditionary forces in France. Lieutenant Colonel Lamont received his commission in February, 1918, and has been at the head of the raw materials section of the procurement division.

F. J. Ryan has resigned as secretary-treasurer and general manager of the Electric Furnace Construction Co., Philadelphia, and has disposed of his interest in that company. He occupies a similar position with the American Metallurgical Corp., Franklin Trust building, that city, in which he is one of the largest stockholders. The American Metallurgical Corp. controls the Philadelphia Electric Steel Corp., which operates a plant at Conshohocken, Pa. S. R. Vanderbeck, who has resigned as vice president of the Electric Furnace Construction Co., has been elected president of the Metallurgical Corp. S. H. Ourbacker, electrical engineer, and F. A. Shaw, purchasing agent, also have resigned from the former company to take up respective positions with the American Metallurgical Corp.

National Association of Patternmakers Organized

At a meeting of the Interstate Pattern Manufacturers' association, representing an organization of patternmakers in Ohio, Indiana, Michigan and western Pennsylvania, and the National Association of Employers of Patternmakers, whose membership is largely in the east and New England, it was decided to combine the efforts of both organizations and a new society was formed, known as the National Association of Patternmakers.

This organization will include not only producers of patterns for the jobbing trade, but also pattern shops operated as departments of industrial plants. Firms or individuals, engaged in the manufacture of patterns, are eligible to membership. Sectional locals have been organized in various parts of the country which will hold membership in the national body. It was decided to hold the next annual convention in Buffalo, Aug. 16, 1919.

Officers were elected as follows: President, E. F. Ball, Newark Stamping & Foundry Co., Newark, O.; first vice president, Max A. Sills, Superior Pattern Works Co., Cleveland; second vice president, J. H. Bridge, Maumee Pattern Co., Toledo; treasurer, E. O. Melvin, Melvin Bros. Co., Columbus, and secretary, T. T. McGuire, Columbus. The following trustees were chosen: A. E. Schuchert, A. E. Schuchert Pattern Works, Cincinnati; S. H. Thompson, Thompson Mfg. Co., Dayton, O., and Mr. Poole, Maumee Pattern Co., Toledo, O.

Portable Ladle Heaters

A number of new torches have been added to the oil-burning equipment manufactured by the Hauck Mfg. Co., Brooklyn, N. Y. In the accompanying illustration, Fig. 1 shows a portable hand pump type ladle heating oil burner mounted on a truck. This is adapted for use with kerosene as fuel. The burner is detachable from the burner stand and can be employed for other heating work. This equipment consists of a 5 or 10-gallon tank with hand pump pressure gage and all fittings mounted on a truck equipped with 18-inch wheels and an adjustable stand. Another ladle heating outfit equipped to burn kerosene, crude or fuel oil and adapted for heating ladles is illustrated in Fig. 2. It consists of a 5 or 12-gallon tank with pressure gage and fittings mounted on a truck with 18-inch wheels and an adjustable stand.

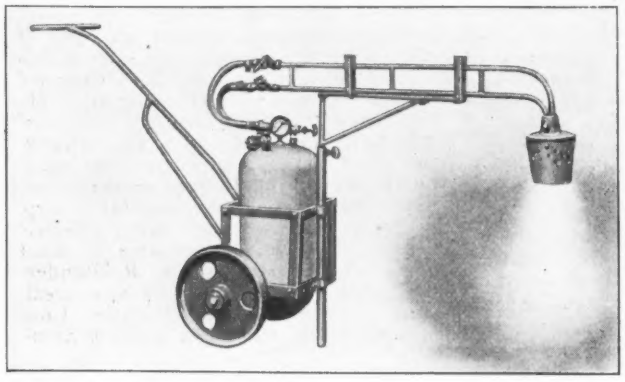

FIG. 1—PORTABLE, KEROSENE-BURNING LADLE HEATER MOUNTED ON A HAND TRUCK

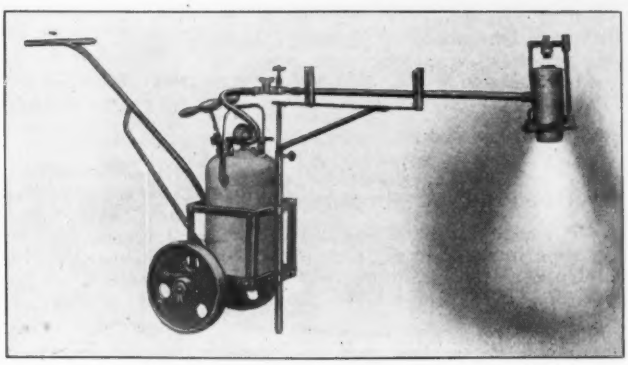

FIG. 2—PORTABLE LADLE HEATER WHICH MAY BE OPERATED WITH KEROSENE OR CRUDE OIL

The compressed air torch, illustrated in Fig. 3, is especially adapted for skin-drying molds, brazing, preheating and other heating operations. Fuel or crude oil or kerosene may be employed. It may be operated with compressed air at any pressure. The compressed air syphons the oil to the burner and, therefore, there is no pressure in the tank at any time. The tank has a capacity of ½ gallon, although it is furnished with tanks of 1 gallon and 1½ gallon capacity.

Coremaking Discussed by Richard Moldenke

"Coremaking" is the title of a small but handy volume written by Dr. Richard Moldenke for the Corn Products Refining Co., New York. Appreciating that many of the foundry losses are attributable to improper coreroom practice and in view of the limited information available on coremaking, the Corn Products Refining Co. concluded that it would be advisable to obtain authoritative information bearing upon coreroom progress. The services of Dr. Richard Moldenke were obtained and he made an extensive line of tests with various core binders, sand mixers, pouring temperatures, etc., which will prove to be of the utmost value to foundrymen. In addition a large number of tables are included, such as recommended analyses for various classes of castings, weights of cast iron, melting points of cast iron, brass, etc., cupola melting losses and a valuable digest of scrap specifications.

Concrete Foundry Floors

Some interesting observations concerning the use of concrete for foundry floors are contained in a paper by George Moyer, Textile Machine Works, Reading, Pa. In this paper, which was presented at the 1918 meeting of the American Foundrymen's association, Mr. Moyer says in part:

"My practical experience with concrete foundry floors extends over the past 10 years. I find this type floor to be superior to any other foundry flooring for a number of reasons.

"The concrete floors can be kept clean easily and with little expense of labor and time. Molds will always stand level and straight, avoiding the not inconsiderable loss of castings resulting if the molds are not level. The molder cannot dig holes in a concrete floor with his shovel, which is frequently the case on other floors. The straight and smooth surface will always give the men carrying iron a safe path, free from holes found in an ordinary clay or gravel floor.

FIG. 3—COMPRESSED AIR TORCH FOR SKIN-DRYING MOLDS, BRAZING, PREHEATING, ETC.

"In the foundry with which the writer is connected, all the cores are distributed by an electric truck and on account of the concrete floor we can transport without breaking any style of core. In case a sand-cutting machine is used to cut the sand the numerous advantages are obvious. The strain on the machine is naturally much less on a level, solid foundation and the blades can cut all the sand down to the ground without taking any chance of damaging the machine.

"The argument that concrete causes discomfort to the molders' feet does not hold good as experience proves that the molders are always standing on sand just as they do on gravel or clay floors. I have found the concrete foundry floors to be a complete success and I know that if I would give our molders the choice between clay and concrete floors they would all prefer the latter."

New Tin Plating Bath

According to a Swiss patent recently issued, metal objects may be tin plated, by the use of a bath consisting of sodium or potassium hydroxide, 5 parts; tin nitrate, 1 part; tin chloride, 1 part; borax, 1 part; gelatin, 1 part, and water, 91 parts by weight. Tin is deposited from the bath at a temperature of from 90 to 100 degrees Cent. The object to be plated is suspended as the cathode and a pure tin anode is used in connection with the bath.

Portable Elevating Conveyors

When unskilled labor was cheap and plentiful, the problem of handling materials of various kinds did not receive the general attention of foundrymen, owing to the fact that there was no heavy demand for appliances to take the place of ordinary labor. Today, however, the situation is different. Labor is scarce, wages are high and, because well paying jobs are plentiful workmen cannot be depended upon to stick to their job. Thus, it is natural to turn seriously to machinery to take the place of labor heretofore employed in handling materials.

This situation has hastened the development of light, portable conveying appliances, one of which is shown in the accompanying illustration. This device is manufactured by the Barber-Greene Co., Aurora, Ill. The illustration shows two portable belt conveyors loading coke into railroad cars. It is said that the cars are loaded in two to four hours, the time depending on the size and type.

The Barber-Greene Co. has developed several types of conveyors to handle different materials. For elevating at angles under 25 degrees, it has been found that a plain belt gives excellent results. With angles from 30 degrees and upward, however,

TWO PORTABLE CONVEYORS ADAPTED FOR LOADING COKE INTO CARS OR FOR UNLOADING FROM THE CARS TO STOCK PILES

the belts are equipped with steel flights to prevent the material from slipping down grade. The conveyors are made portable by mounting them on wheeled trucks or by suspending them from a trolley attached to an overhead steel cable.

At the present time, portable conveyors can be adapted to a variety of applications. Among these are the unloading of cars of coke or pig iron into piles, storage sheds, wagons, motor trucks or buggies, or *vice versa*. When the distance the material has to be conveyed is comparatively long, two or more conveyors can be worked in combination.

New Bucket Loader for Sand Mixers

In line with the substitution of machines for men in every line of industrial activity is the new bucket loader manufactured by the National Engineering Co., Chicago, for use with its foundry sand mixer. This loader, shown in the accompanying illustration, is designed for operation from the same shaft which actuates the mixer. A sprocket is set on the continuation of the mixer shaft, the dead end of which is shown beneath the mixer pan. The sprocket drives a gear by means of a chain. This gear is keyed to a second shaft, which idles until connected through a clutch to a drum. The drum, in turn, winds the cable which is coiled about the larger pulley shown at the top of the structural framework or elevating tower. Two smaller pulleys on the same shaft reel in the two lines of cable connected to the sides of the bucket, thus raising the bucket to the position shown. When the clutch is released, the bucket is lowered automatically against a brake until in position to receive an addition charge of sand.

BUCKET LOADER FOR SAND MIXER IS OPERATED WITH THE SAME DRIVE SHAFT AS THE MIXER

The Booth-Hall Co., Chicago, recently has obtained contracts for installing electric steel furnaces in the following plants: Consumers Steel Co., Chicago, one 3-ton furnace for producing tool steel, and Ecorse Foundry & Machine Co., Ecorse, Mich., one 3-ton furnace for steel castings.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Frank Foundry & Machine Co., Moline, Ill., is building an addition to its plant, 25 x 40 feet.

Work has been started on the erection of an addition to the Rands Iron Works, Vancouver, Wash.

The Green Bay Foundry & Machine Works, Green Bay, Wis., is erecting an addition to its plant.

The North End Foundry Co., West Allis, Milwaukee, Wis., is building an addition, 60 x 80 feet.

The Bay City Foundry & Machine Co., Bay City, Mich., is erecting a foundry, 110 x 200 feet.

Leitelt Bros., 7731 South Chicago avenue, Chicago, is contemplating the enlargement of its foundry.

The St. Maurice Foundry Co., Trois Rivieres, Que., plans the erection of an addition.

The U. S. Cast Iron Pipe & Foundry Co., Addyston, O., plans the erection of additions to its plant.

A. Ospal, 750 Fifteenth avenue, Vancouver, B. C., recently awarded a contract for the construction of a foundry and machine shop.

The Independent Brass Foundry, Louisville, Ky., recently obtained several copper and brass contracts for indirect government work.

A $100,000 foundry is to be built at New London, Conn., by the bureau of yards and docks, navy department, Washington.

The Smith & Watson Iron Works, 412 Front street, Portland, Ore., is contemplating the erection of a foundry, 50 x 100 feet.

A. D. McDougall and Nat McDougall of Guthrie & Co., Portland, Ore., and Charles C. Overmire, have leased a plot of land 200 x 680 feet, on which they plan to erect a foundry and machine shop.

C. E. Braun, 503 Market street, San Francisco, is having plans prepared for the erection of a foundry.

The Prier Brass Mfg. Co., Marshalltown, Iowa, recently awarded the contract for the erection of a brass foundry addition, 60 x 150 feet.

The Alten Foundry & Machine Works Co., Lancaster, O., will build a foundry and machine shop addition to its plant.

The Fairbanks Co., Binghamton, N. Y., is having plans prepared for the erection of an addition to its foundry, 40 x 72 feet.

The Mahoning Foundry Co., 618 Poland avenue,

Youngstown, O., has awarded a contract for the erection of a foundry, 140 x 200 feet.

The Aluminum Castings Co., 207 Crawford avenue, Detroit, recently awarded contracts for alterations and the erection of an addition to its foundry.

The Kennedy Foundry Co., Charles and Wells streets, Baltimore, is in the market for welding machines for the manufacture of semi-steel shells.

The James A. Brady Foundry Co., Weston avenue and Forty-fifth street, Chicago, G. S. Burtis, president, is erecting a foundry addition, 90 x 90 feet.

The La Crosse Plow Co., La Crosse, Wis., recently awarded a contract for the erection of a foundry, 40 x 100 feet.

The Crompton & Knowles Loom Works, 93 Grand street, Worcester, Mass., will build an addition to its foundry, 45 x 45 feet.

The Hendry Foundry Co., Vancouver, B. C., is contemplating the erection of a foundry, 60 x 80 feet, adjoining its present plant.

The Southern Pacific railroad, San Francisco, is said to be contemplating the erection of a steel foundry addition to its plant at Sacramento, Cal.

Henry Wray & Sons, 193 Mill street, Rochester N. Y., manufacturers of brass castings, is building an addition to its foundry.

The Portland Foundry Co., Portland, Conn., has purchased a site adjoining its property on which it will erect several additions.

The Light Mfg. & Foundry Co., Pottstown, Pa., has awarded a contract to Fred H. Keiser & Co. for the erection of a foundry, 25 x 190 feet.

The Salmon Bay Foundry Co., 5320 Twenty-fourth avenue, Seattle, Wash., is contemplating the erection of a foundry, 40 x 144 feet.

The Pacific Car & Foundry Co., 219 East Sixtieth street, Portland, Ore., is having plans prepared for the erection of a plate shop, 100 x 340 feet.

The Beach Foundry Co., Ottawa, Ont., is having plans prepared for the erection of a foundry as an addition to its present plant.

The Gerlinger Steel Castings Co., Fifty-ninth and National avenues, West Allis, Milwaukee, Wis., is building a foundry 80 x 184 feet.

The Columbia Machine Works & Malleable Iron Co., 269 Chestnut street, Brooklyn, is building a foundry addition to its plant.

The Russell Foundry & Machine Works, Long Island City, N. Y., contemplates the erection of an addition to its plant, 25 x 100 feet.

The Commercial Steel Castings Co., Marion, O., which was organized several months ago, has placed its foundry in operation. The building is 120 x 190 feet and has a capacity of about 20 tons a day.

The Lebanon Steel Foundry, Lebanon, Pa., plans the construction of an addition to its plant and has retained A. R. Richter, Reading, Pa., as architect.

The American Car & Foundry Co., Milton, Pa., has awarded a contract to the Austin Co., Cleveland, for the construction of an 83 x 100-foot plant addition.

The Milwaukee Steel Foundry Co., Water and Virginia streets, is building an addition to its plant and contemplates the installation of a 3-ton electric furnace.

Bids are now being taken for the erection of a foundry building for the Hessler Foundry & Mfg. Co., Mitchell street, Oswego, N. Y. Plans call for a building 60 x 260 feet.

Thomas and William Mellow, proprietors of the Liberty Foundry, St. Louis, have purchased the plant of the Gravois Foundry & Mfg. Co., that city, and the two plants will continue to be operated separately.

The Atlas Brass Foundry, Los Angeles, has been incorporated with a capital of $10,000 to engage in the manufacture of brass castings. M. M. Anderson, Charles W. Lyon and Frederick W. Heyser, Los Angeles, are the incorporators.

The Northern Foundry Co., Marinette, Wis., has purchased the plant and business of the Dost Pattern Co., Menominee, Mich., and is moving the machinery and equipment from Menominee to its main plant now being enlarged.

The General Aluminum & Brass Mfg. Co., 2512 East Grant boulevard, Detroit, has awarded a contract for the erection of an aluminum foundry, 100 x 100 feet, and two 40 x 100 and 60 x 180-foot brass foundries.

James Aylward & Sons Co., Neenah, Wis., has awarded a contract to the C. R. Meyer Construction Co., Oshkosh, Wis., for the erection of a gray iron foundry addition.

The Charles Bohn Foundry Co., 738 Hart avenue, Detroit, has had plans prepared for the erection of an addition, 40 x 120 feet, at Chene and Finley avenues.

The Lincoln Way Brass Foundry Co., South Bend, Ind., has been incorporated with $18,000 capital. The directors are Sherman P. Stults, Charles Heckathorn and Henry Johnson.

The Knight Co., Sutter Creek, Cal., operating a foundry for the manufacture of mining machinery, has acquired the plant and planing mill of D. V. Ramazzotti.

The Chase Foundry & Mfg. Co., Parsons avenue, Columbus, O., is having plans prepared for the reconstruction of its foundry which was recently damaged by fire.

It was recently announced that the plant of the Manitowac Foundry & Machine Co., Manitowac, Wis., had been sold to David Balkansky, and would be enlarged.

A permit recently was issued to the Canton Steel Foundry Co., Canton, O., permitting it to erect an addition to its plant. The contract for the work has been let to the Boldt Construction Co.

L. P. Graham, 1503 Tenth avenue, Seattle, has been awarded a contract by the Franklin Tool Works 6323 Seventeenth avenue, Seattle, to erect a foundry, 80 x 100 feet.

The Reed Foundry & Machine Co., Kalamazoo, Mich., manufacturer of tractors, is operating its foundry at about 75 per cent for the government. It is making steel castings, hydraulic parts and iron working lathes.

The H. W. Clark Co., Mattoon, Ill., manufacturer of meter boxes and water works appliances, is rebuilding its foundry and machine shop and is purchasing a large amount of foundry equipment, as well as machine tools and accessories.

The Advance Foundry Co., Harshman and Crane streets, Dayton, O., is erecting a plant of brick and steel construction, 100 x 200 feet. Several other smaller buildings that are necessary in the operation of a foundry are to be erected.

The American Car & Foundry Co., 370 Babcock street Buffalo, is planning the erection of an addition to its Babcock street car construction and repair shops. Plans for alterations to its foundry have been filed with the city building commissioner.

The General Machinery Co., Spokane, Wash., contemplates the enlargement of its plant at Riverside avenue and Freya street, according to a recent announcement of E. J. Simmons, general manager. Land which was recently purchased, will be occupied by the foundry and machine shop.

The Chain Belt Co., 736 Park street, Milwaukee, is enlarging its malleable iron foundry and contemplates the erection of other additions. The improvements to the plant have been made necessary by large government contracts which the company has received.

Architect Francis W. Grant, Mehlhorn building, Seattle, Wash., has completed plans and will accept contractors' figures at once for the general contract in connection with the reconstruction of the Aurora Foundry on Horton street. The new building will be 70 x 120 feet and will be equipped with an electric furnace and a traveling crane.

The Massillon Steel Castings Co., Massillon, O., is extending its plant, adding 50 per cent to its foundry floor space and doubling its sand-blasting equipment. A standard 42-inch sand blast barrel will be installed. The company is putting in a new type of annealing furnace. A steam boiler plant will be provided for heating the foundry.

The Lucey Foundry & Machine Co., Chattanooga, Tenn., with a capital of $300,000 has been incorporated by J. R. Higgins, J. P. Hoskins, W. H. Dewitt, R. H. Williams and George D. Lancaster. Extensive improvements are to be made to the plant of the Chattanooga Car & Foundry Co., which was recently purchased by the Lucey interests.

NEW TRADE PUBLICATIONS

FOUNDRY EQUIPMENT—The extensive line of pressed steel flasks, steel slip jackets, steel flask bands, steel bottom boards, core plates, strike plates, loading skips, ladle handles and tote pans, manufactured by the Peck Iron & Steel Works, Kalamazoo, Mich., is illustrated and described in a catalog recently issued by this company. Foundries generally are discarding wooden flasks, slip jackets, etc., and are replacing this equipment with that constructed of steel.

OXYGEN AND HYDROGEN GENERATORS—The improved electrolytic oxyhydrogen generator built by the International Oxygen Co., 115 Broadway, New York, is illustrated and described in a 24-page catalog recently issued. It contains dimensions and capacities and working plans of two typical plant layouts, showing the extreme compactness of this new cell.

CIRCUIT BREAKERS—A bulletin recently issued by the General Electric Co., Schenectady, N. Y., is devoted to oil circuit breakers for industrial circuits up to 300 amperes and 2500 volts. While these circuit breakers are totally enclosed for the purpose of rendering them dust-proof, they are not intended for installation out of doors unless protected by shelter or housing. The bulletin contains details regarding capacity, as well as numerous wiring diagrams.

SAND-BLASTING—An exceedingly novel booklet, entitled "Some Sand-Blasting Fallacies," prepared by R. R. Shuman, Chicago, has been issued by the U. S. Silica Co. of that city. It is profusely illustrated with striking cartoons.

ZINC AND ZINC PRODUCTS—The New Jersey Zinc Co., 55 Wall street, New York, has issued four booklets containing a fund of information on zinc and zinc products. Under the title "Zinc Dust" is considered the standard or fumed, and the atomized zinc dust used in producing high grade zinc coatings. The production, uses, new developments and future possibilities of rolled zinc are treated in the second booklet. "Zinc Oxides" treats of pharmaceutical zinc oxide, French process and American process zinc oxides, with much practical information concerning the physical and chemical properties and uses of these grades. Under "Metals" the fourth booklet is given a thorough discussion on spelter, metallic zinc, spiegeleisen, and lead bullion. These four publications form an interesting series, and are worthy of place among reference works.